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Agriculture and Rural Development Discussion Paper 24

Factors Affecting Supply of Fertilizer in Sub-Saharan Africa

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ARD
AGRICULTURE AND RURAL DEVELOPMENT

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About the Authors

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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 African. 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).

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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.

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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).

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

Acronyms and Abbreviations

AIBDF	Agricultural Inputs Business Development Fund
AIIF	Agricultural Input Import Fund
AIMs	agricultural input markets
AS	ammonium sulfate
CAN	calcium ammonium nitrate
c.& f.	cost and freight
c.i.f.	cost, insurance, and freight
CLUSA	Cooperative League of the United States of America
CPPs	crop protection products
DAP	diammonium phosphate
ECA	Economic Commission for Africa
ECOWAS	Economic Community of West African States
f.o.b.	free on board
FSP	Fertilizer Support Program
GDP	gross domestic product
ha	hectare
kg	kilograms
km	kilometers
KRII	Kennedy Round 2
L	liter
LC	letters of credit
MAP	monoammonium phosphate
MINADER	Ministry of Agriculture and Rural Development
MIS	market information system
MOP	muriate of potash
Mbtu	million British thermal unit
MZM	Malawi-Zambia-Mozambique
NAFCON	National Fertilizer Company of Nigeria, Ltd.
NGOs	non-governmental organizations

NPK	$N+P_2O_5+K_2O$ (Nitrogen + Phosphate + Potash)
P	phosphorus
PR	phosphate rock
SADC	Southern African Development Community
SSCR	shifting the supply curve to the right
SSA	Sub-Saharan Africa
SOEs	state-owned enterprises
TAZARA	Tanzania-Zambia Railway Authority
TIP	targeted input program
tons	metric tons
tpd	tons per day
tpy	tons per year
TSP	triple superphosphate

Executive Summary

In Sub-Saharan Africa, fertilizer use is low (8 kg/ha) and inadequate to replace the nutrients removed in harvested crops. In the global context, SSA accounts for less than one percent of global fertilizer use and a much smaller proportion in production. During the 1990s, fertilizer use was static. This stagnation at low levels does not augur well for confronting food insecurity and environmental degradation problems. Several measures will be needed to improve fertilizer use in SSA, but improved access to fertilizers at the village level will be the critical one.

Policy reforms are necessary but not sufficient to create well-functioning fertilizer markets in Africa. A pro-active approach is needed to build the private sector capacity (input dealers) for input supply in the rural areas. A holistic approach focusing on the five pillars of market development and supporting conditions is essential for creating well-functioning fertilizer markets. The five pillars refer to (a) policy, (b) human capital, (c) finance, (d) market information, and (e) regulation.

In spite of liberalization and deregulation, many distortions exist in various countries. There is a "mindset" problem; policy makers do not trust the private sector and use it as an excuse to introduce more distortions. Policy distortions or interventions by the government or donors need to be removed. To improve communication between policy makers and the private sector, public-private agribusiness forums could be created and public-private partnership promoted.

Liberalization and deregulation have encouraged the entry of the private sector in the fertilizer market, but many factors still constrain the private sector from realizing its full potential. The fact that there are many input dealers involved in the input business shows that the private sector can effectively supply inputs, provided the constraints affecting its involvement are removed. Rather than following the subsidy route, shifting the supply curve to the right (SSCR) approach could be used to reduce transaction costs by focusing efforts on the five pillars of market development and the supporting conditions. To improve fertilizer supply in rural areas, human capital needs to be developed and access to finance and market information be strengthened. Effective enforcement of regulatory frameworks is essential so that honest dealers are not "crowded out" by unscrupulous traders. Improvements are also needed in the procurement, marketing, and transportation of fertilizers through multi-country trade. Better business linkages among importers in landlocked countries and coastal countries can yield significant cost savings.

Until the size of the fertilizer market is large enough to realize the economies of scale in production, SSA countries can rely on imported fertilizers without compromising their sovereignty or security. Steps could be taken to reduce procurement costs through various measures including better access to foreign

exchange. Retail networks need to be established in rural areas, and market-friendly safety nets are required to bring non-market participants—usually the resource-poor subsistence food crop farmers—into the market process through linkages to input suppliers and technology transfer efforts. If implemented effectively, the proposed measures have a promise of making significant improvements in fertilizer supply to smallholder farmers in Sub-Saharan Africa.

1. Introduction

The agriculture sector is the dominant sector in most countries of Africa, especially in Sub-Saharan Africa. It provides employment to most of the people in rural areas and makes significant contributions to the gross domestic product (GDP) and foreign exchange earnings. Because of its dominant role in the economy and society of African countries, agriculture has been called the engine of economic growth. In spite of its dominant role, agricultural productivity is low and the people depending on agriculture are generally poor. Increased productivity in the agriculture sector mandates that African farmers move from the traditional mode of agricultural production to one based on science and technology. Science-based agriculture is embodied in the use of modern inputs such as improved seed, fertilizers, crop protection products (CPPs), and other improved agronomic practices. Although other inputs are necessary, this paper's main focus is on fertilizers because fertilizer use is low and nutrient depletion from the soils is causing serious soil degradation. Although factors affecting both demand and supply of fertilizers require analysis and assessment, the issues related to the supply side of the fertilizer market equation are discussed here because inadequate and untimely supply of fertilizers at the farm gate itself is a primary cause of low fertilizer use in Sub-Saharan Africa (SSA). In a continent where farmers must travel 20–30 kilometers (km) to buy a bag of fertilizer, one cannot expect poor farmers to use fertilizer. The underdeveloped and fragmented nature of the fertilizer market in rural areas is caused by many factors including policy, institutional, infrastructural, political, and economic. Improving the supply of fertilizers requires alleviating all those constraints that affect the fertilizer supply chain at both national and regional levels in Africa.

This paper provides a comprehensive overview of the factors that determine the availability and cost of fertilizer at the farm level including technical, economic, institutional, and other factors. It includes empirical data, especially with regard to the various costs associated with manufacturing, procurement, transportation, storage, packaging, and distribution, and provides an analysis of policy and other factors affecting the performance of the fertilizer market. Emphasis is placed on the countries of SSA although statistical data are provided for North Africa and the Republic of South Africa.

A well-functioning fertilizer market requires that the policy environment is conducive, human capital is adequate (in both quantity and quality), access to finance and market information is easy, and regulatory frameworks are effectively enforced. Additionally, infrastructures linking the various segments of the market are in working order, physical property is protected, and farmers are fully informed about the benefits of various technologies.

To understand the functioning of the fertilizer market in various countries and SSA as a whole, the remaining paper is divided into eight sections. The next section provides a brief background on agriculture and fertilizer use in SSA. Sections 3 and 4 deal with the structure of the fertilizer industry and emerging trends at the global and regional levels; and places SSA in the global context. Trends in fertilizer consumption, production, trade, and technologies are described. These two sections underscore the idea that trade has become an important source of fertilizer supply in many regions of the world and therefore SSA's dependence on fertilizer trade should not be considered an "alarming" disadvantage. This is not to suggest that where viable, SSA cannot produce fertilizers. Rather, SSA need not become a victim of the "fertilizer self-sufficiency" syndrome *per se*. Factors affecting fertilizer supply are elaborated in Section 5. These factors are broadly divided into three groups: (a) market development-related, (b) technical, and (c) infrastructural. The conceptual framework, based on shifting the supply curve to the right (SSCR), is developed in Section 6. The SSCR approach defines the logic of reducing fertilizer prices without introducing subsidies and assumes that if the factors constraining the functioning and performance of fertilizer markets are alleviated, fertilizer supply will improve at cost-effective prices in rural areas. The next section deals with the various components of supply chain in a generic sense and contrasts them with the situation in SSA. This explanation is followed by examples from four settings: large and small coastal markets and medium and small landlocked markets, and identifies areas where the inefficiencies occur. Section 8 is devoted to the measures needed to strengthen the functioning of the fertilizer market; these measures are divided into two groups, namely, the five pillars of market development and supporting measures. Options for fertilizer production and market-friendly safety nets are also analyzed here, with the recognition that even the most efficient fertilizer markets may not reach all the farmers, especially those who are too poor to participate in the market process. Market-friendly safety nets are proposed to help such groups. The last section provides the summary and conclusions of the paper.

Although not clearly clustered as such, the issues covered and the measures proposed in the paper touch on two broad themes: (a) strengthening the functioning of the fertilizer market and (b) empowering the stakeholders in the marketplace so that they can derive maximum benefits from well-functioning fertilizer markets at all levels (i.e., local, national, regional, and global).

2. An Overview of Agriculture and Fertilizer Use in Sub-Saharan Africa

Historical Context with Comparison to Asia

Sub-Saharan African agriculture has a unique set of characteristics that make it very different from Asia, and these characteristics have impeded development for most of the continent of a similar "Green Revolution" (IAC 2004). These include:

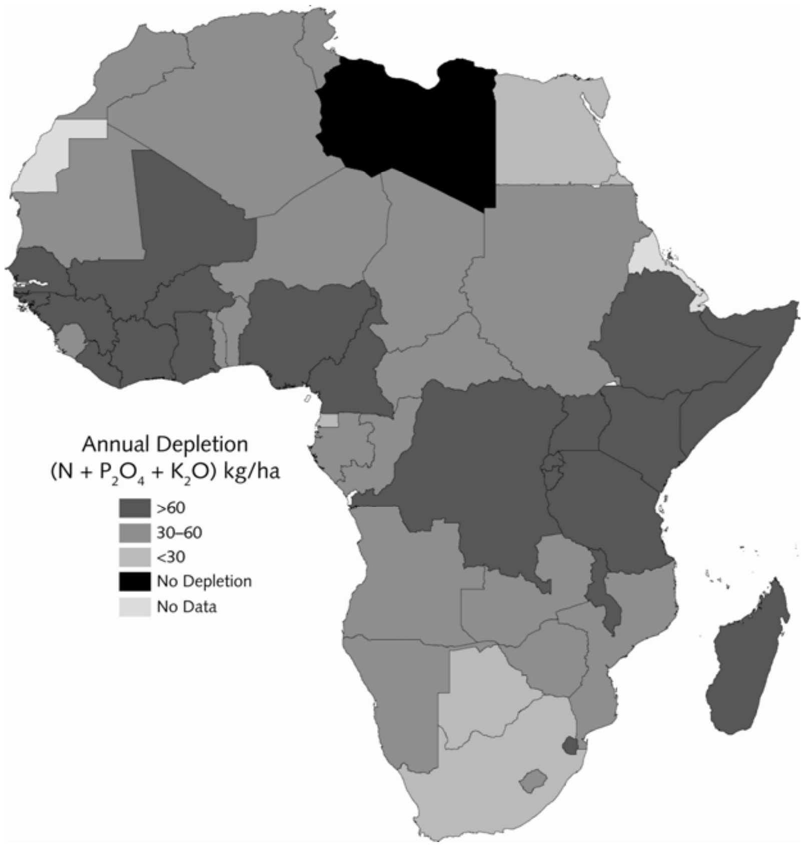
- Lack of a dominant farming system.
- Predominance of rainfed agriculture.
- Diversity in farming systems and importance of livestock.
- Dominance of soils of inherent poor fertility.
- Key roles of women in farm production.
- Lack of functioning competitive markets.
- Lack of a conducive economic and political enabling environment.
- Predominance of customary land tenure.
- Low and stagnant labor productivity.
- Under-investment in agricultural R&D and infrastructure.
- A large and growing negative impact of poor human health on agriculture.

As a result of the combination of these factors such as low inherent soil fertility, uncertain water availability during the growing seasons, poverty, inappropriate land management practices of extensification, and inappropriate policies that are not supportive of agriculture; depletion of soil fertility is a significant and growing cause of low agricultural productivity and per capita food production. The future of extensification in farming practices is limited and environmentally unsound.

Nutrient Mining

Depletion of soil fertility is a primary cause of low per capita food production in SSA (Bremen et al. 2001; Pieri 1989; Rabbinge 1995; Sanchez 2002). Smallholders have removed large quantities of nutrients resulting in a high annual depletion rate—22 kilograms (kg) of nitrogen, 2.5 kg of phosphorus (P), and 15 kg of potassium per hectare (ha) of cultivated land over the past 30 years in 37 African countries—an annual loss equivalent to $4 billion in inorganic fertilizer (InterAcademy Council 2004). These regional averages mask variations in nutrient depletion at the country level. In some countries, annual depletion of nutrients exceeded 60 kg/ha during the 1993–95 period (See figure 2. 1**).**

Figure 2.1 Average Annual Rates of Nutrient (NPK) Depletion in Africa (Years 1993–1995)



Source: Henao and Baanante 1999.

Fertilizers have been applied to counteract loss of nutrients most consistently in the commercial and irrigated farming systems. In the more widespread rain-fed farming systems, there has only been limited use. At the very low soil fertility levels, the efficiency of fertilizer use is extremely low and, with the often-poor input-output price ratios and difficulties of market access, effective demand is very low. Fertilizer nutrient use per hectare in SSA in 2002/03 was only 8 kg and for Africa as a whole, including the irrigated markets of North Africa, was 20 kg. Figure 2.2 illustrates how abysmally low this use is compared with that of all other regions of the world except Eurasia where the adjustments to the previous centrally planned economies have been slow to materialize.

Global fertilizer nutrient consumption was 141.6 million tons[1] in 2002/03 of which Africa accounted for only 3% or 4.2 million tons (See table 2.1). North Africa consumed 1.9 million nutrient tons in 2002/03, SSA 1.4 million tons, and South Africa (RSA) less than 1 million tons. SSA nutrient consumption was less than 1% of the global total (See table 2.2). For the past decade total nutrient consumption in SSA has been static (See figure 2.3). At the country level, the size of the fertilizer market is even smaller[2] (See table 2.3). Of the 44 countries, only 7 countries used more than 50,000 nutrient tons, whereas 25 countries used less than 10,000 nutrient tons. The implications of "thin" markets translate into higher procurement and marketing costs and poor outreach.

Table 2.1 World: Fertilizer Consumption by Regions, 2002/2003

Region	**2002/2003**			
	N	**P_2O_5**	**K_2O**	**Total**
	('000 nutrient tons)			
North America	12,508	4,513	4,891	21,912
Western Europe	9,061	2,886	3,195	15,142
Oceania	1,296	1,493	373	3,162
Eastern Europe	2,407	609	622	3,638
Eurasia	2,690	626	770	4,086
Africa	2,749	991	538	4,278
Latin America	5,044	4,184	4,002	13,230
Asia	48,989	18,252	8,881	76,122
World	84,746	33,552	23,273	141,571

Source: Derived from FAO data.

Note: See Annex B for regional and sub-regional classification.

Table 2.2 Fertilizer Consumption in Africa by Sub-Regions, 2002/2003

Subregion	**2002/2003**			
	N	**P_2O_5**	**K_2O**	**Total**
	('000 nutrient tons)			
North Africa	1,440	350	140	1,930
Sub-Saharan Africa	739	409	235	1,384
South Africa	571	231	163	965
Total Africa	2,749	991	538	4,278

Source: Derived from FAO data.

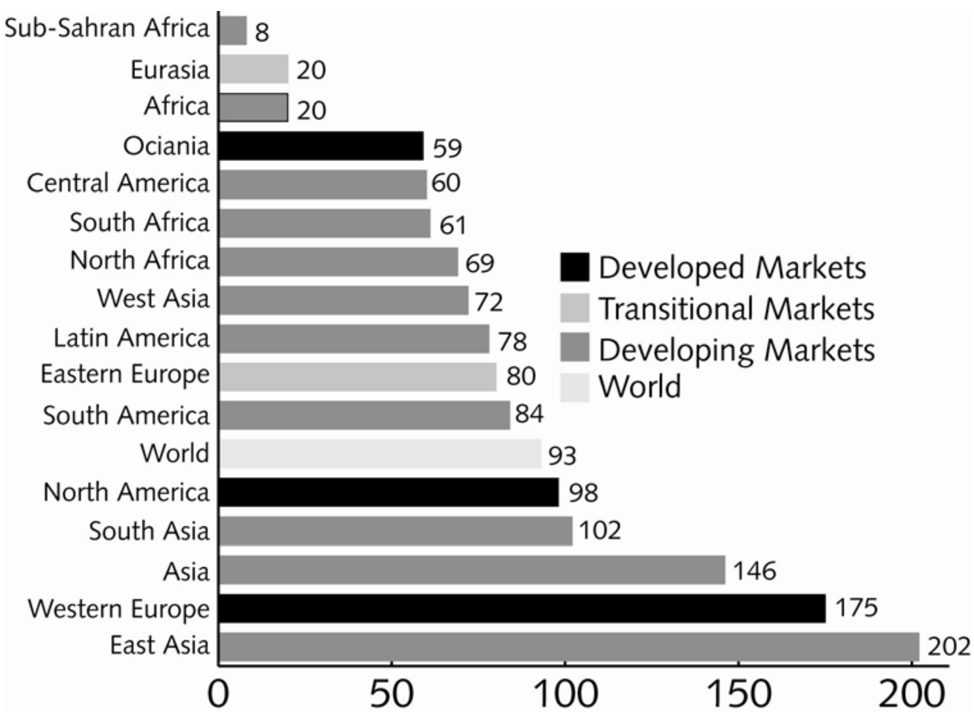
Table 2.3 Sub-Saharan Africa: Distribution of Countries by the Level of Fertilizer Use, 2000–2002 Annual Average

Fertilizer Use		Number of Countries
(nutrient tons)	(product tons)[a]	
Less than 10,000	Less than 25,000	25
10,000–30,000	25,000–75,000	6
30,000–50,000	75,000–125,000	6
50,000–100,000	125,000–250,000	3
100,000–150,000	250,000–375,000	3
Over 150,000	Over 375,000	1
Total		44

[a] Product tons are estimated based on 40% nutrient concentration.

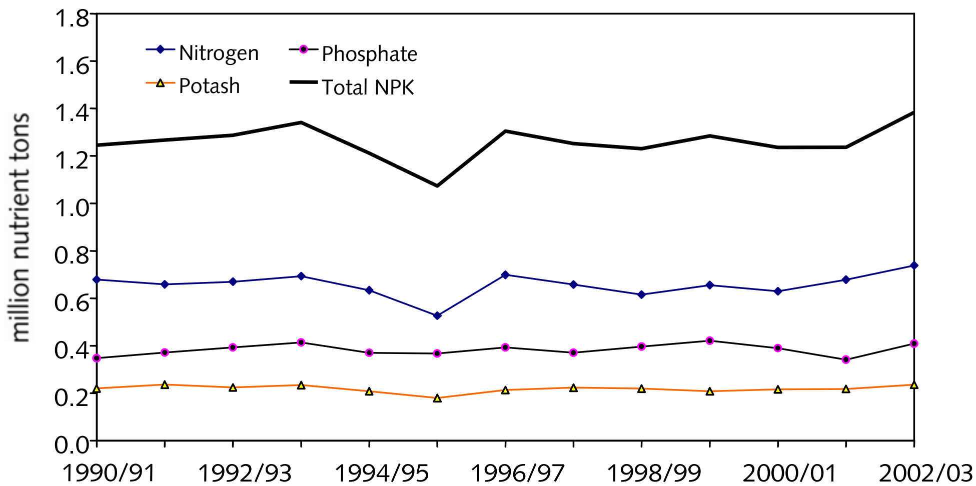
Source: Derived from FAO data.

Figure 2.2 Per Hectare Fertilizer Use by Markets, 2002/2003 (kg/ha)



Source: Derived from FAO data.

Figure 2.3 Sub-Saharan Africa Nitrogen, Phosphate, Potash, and Total NPK Consumption, 1990/1991 – 2002/2003



Source: Derived from FAO data.

3. Fertilizer Raw Material, Production, and Supply-Side Constraints

The supply side of the fertilizer market equation also represents unique challenges in SSA. The supply of fertilizer nutrients for agriculture requires raw materials—natural gas, phosphate rock (PR), sulfur, and potassium salts—for fertilizer production. SSA is deficient in raw material resources. SSA is essentially deficient in supplies of natural gas; exceptions are Nigeria, Angola, Equatorial Guinea, Ethiopia, Mozambique, Namibia, Democratic Republic of Congo, Madagascar, and Tanzania. Substantial commercial PR deposits exist in Togo and Senegal although there are numerous smaller deposits throughout SSA. There are no commercial reserves of potash. Reserves in the Congo exist, but they are no longer commercially attractive. The situation is far different in North Africa and the Republic of South Africa (RSA). Morocco is the largest producer of phosphatic fertilizers in Africa and ranks at number six in world production, and Tunisia, Algeria, and Egypt are producers of both phosphates and nitrogen fertilizers. In South Africa there are significant PR deposits and production of phosphate fertilizers. Nitrogen production in RSA is based on coal as the hydrocarbon source rather than natural gas.

Global fertilizer production in 2002/03 was 146.9 million tons of nutrients of which 5.8 million tons (3.9%) were produced in Africa (See table 3.1). North Africa accounted for 5.0 million tons and South Africa 0.6 million tons while production in SSA was only 177,000 tons of nutrients (See table 3.2). This represented 3.0% of Africa's total and just 0.1% of global production. Fertilizer production in SSA peaked at 572,967 nutrient tons in 1992/93, comprising 407,111 tons of nitrogen and 165,856 tons of phosphate. The steady decline in production since then has been due to the closure of the National Fertilizer Company of Nigeria, Ltd. (NAFCON) ammonia/urea plant in Nigeria in 1997 for political reasons and the declining production in Tanzania, Zambia, and Zimbabwe. The decline in fertilizer production in SSA is illustrated in Figure 3.1.

Global Trends in Fertilizer Production

Fertilizers are commodity products, and fertilizer production is a capital-intensive industry that has economic benefits from economies of scale and low raw material costs. The two main costs in fertilizer production are the cost of raw materials (in the short run) and the cost of capital (in the long run). The first variable and the price of fertilizer determine the operating rate of the firm in the short run (i.e., operating capacity utilization). The cost of capital and the production technology efficiency determine the long-run cost structure and capacity of individual firms and the industry. The worldwide rationalization of the fertilizer industry has increased the concentration of production within the main producing countries and the level of concentration among producers within countries. The current productive capacity of the world fertilizer industry for significant nitrogen, phosphate, and potash products is illustrated in Table 3.3. The 13 countries listed in Table 3.3 control most of the production capacity of the world's nitrogen, phosphate, and potash products. Individually, nine countries control more than 50% of the straight nitrogen and DAP/MAP material capacity whereas five countries control 79% of the potash capacity.

Table 3.1 World: Fertilizer Production by Regions, 2002/2003

Region	2002/2003			
	N	P_2O_5	K_2O	Total
	('000 nutrient tons)			
North America	13,279	8,264	8,724	30,266
Western Europe	7,486	1,414	4,528	13,428
Oceania	439	1,013	0	1,452
Eastern Europe	3,309	713	11	4,033
Eurasia	10,388	3,215	8,244	21,847
Africa	3,057	2,734	0	5,791
Latin America	2,666	1,635	785	5,086
Asia	46,583	14,922	3,561	65,065
World	87,206	33,910	25,853	146,969

Source: Derived from FAO data.

Table 3.2 Fertilizer Production in Africa by Sub-Regions, 2002/2003

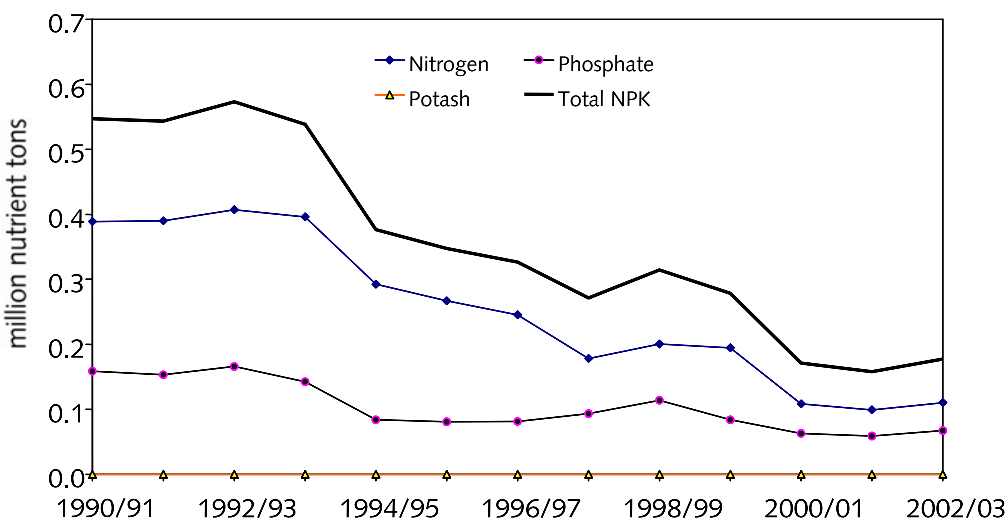
Sub-Region	2002/2003			
	N	P_2O_5	K_2O	Total
	('000 nutrient tons)			
North Africa	2,648	2,387	0	5,036
Sub-Saharan Africa	110	67	0	177
South Africa	298	280	0	578
Total Africa	3,057	2,734	0	5,791

Source: Derived from FAO data.

Table 3.3 Concentration of World Fertilizer Production			
Product	**Countries**	**Capacity**	**% of World**
		(1,000 tons)	
Ammonia	China, U.S., India, Russia, Ukraine	70,740	51%
Urea	China, India, U.S., Indonesia	64,091	53%
AN/CAN	U.S., Russia, China, France, Romania, Poland	30,749	52%
DAP/MAP	U.S., Russia, India, China	14,860	57%
Potash	Canada, Russia, Belarus, Germany, Israel	29,601	79%

Source: IFDC Worldwide Fertilizer Capacity Listings by Plant.

Figure 3.1 Sub-Saharan Africa: Nitrogen, Phosphate, Potash, and Total NPK Production, 1990/1991 – 2002/2003



Source: Derived from FAO data.

Nitrogen Fertilizers

Worldwide trends are for ammonia and nitrogen fertilizer production to become more concentrated in those regions with abundant supplies of relatively low cost natural gas such as that found in Russia, the Middle East, the Caribbean, Australia, and Indonesia. This has led to an increase in trade for both ammonia and nitrogen fertilizers with transportation economies benefiting high-analysis solid fertilizers such as urea and increased investment in joint ventures by fertilizer companies located in countries with no access to low-cost natural gas feedstock.

A modern ammonia/urea production facility with associated infrastructure requires an investment of $500–$700 million and a construction lead time of up to 5 years in a new location with poor infrastructure availability.[3] Production rates from these plants are 1,500–3,500 tons/day (tpd). The capital investment cost per ton of urea production illustrates considerable economies of scale as shown in Table 3.4.

Table 3.4 Investment Cost for Ammonia-Urea Plants of Different Capacities

Option	1	2	3	4	5	6	NAFCON Refurbishment
Urea plant nameplate capacity, tpd	3,500	2,750	2,000	1,500	1,000	500	1,500
Total investment cost, US $ million	549	477	397	343	276	169	150
Investment cost, thousands of US $/daily ton of urea nameplate capacity	157	173	199	229	276	339	100

Source: IFDC 2004a.

Apart from air (as a source of nitrogen), the raw material input of an ammonia/urea production facility consists of one main item, a source of energy (hydrocarbons). Presently, this is usually natural gas, although in some cases it can also be fuel oil, naphtha, or coal. Feedstock for ammonia production accounts for approximately 70% of process costs. The price of natural gas varies considerably from a low value of less than $0.25/MBtu to $5–$6/MBtu. Abundant supplies in Russia and non-market pricing provide Russian ammonia producers with very low natural gas prices. In the Middle East the opportunity cost of natural gas associated with oil production is the very low cost of flaring surplus gas. In the United States, the average cost of natural gas for ammonia production was fairly constant at about $1.90/MBtu during the 1990s. Today the average price is about $5/MBtu, and in recent years spot prices reached $10/MBtu due to shortages in supply and lack of exploration for new reserves. At these higher natural gas prices, U.S. ammonia production has declined, and imports of ammonia and nitrogen fertilizers have increased.

Phosphate Fertilizers

A similar trend has occurred with phosphate fertilizers. Domestic production of phosphate fertilizers was common throughout the world in the 1960s and 1970s based on importation of phosphate rock and sulfur or sulfuric acid for the manufacture of low-analysis single superphosphate fertilizer. The technology developed to produce phosphoric acid and high-analysis phosphate fertilizers such as triple superphosphate and ammonium phosphate fertilizers, containing both nitrogen and P, led to the design of large-scale plants with high daily production rates and products that could be shipped economically around the world. The U.S. phosphate industry stopped exporting phosphate rock in the early 1990s and concentrated instead on value addition by producing and exporting high-analysis phosphate fertilizers. The raw material costs constitute 90% of the production costs of DAP in the United States.

In Europe all production of phosphoric acid for fertilizer production ceased in the early 1990s because production costs became uncompetitive with imports of ammonium phosphates from low-cost producers. This was partially due to the environmental compliance costs associated with the disposal of phosphogypsum, a byproduct of phosphoric acid manufacture.

Potash Fertilizers

Approximately 80% of potash fertilizer production is concentrated in five countries: Canada, Russia, Belarus, Germany, and Israel. There was potash fertilizer production in the Congo from 1969 to 1977, but annual production never exceeded 285,000 nutrient tons compared with the world production of 25.8 million nutrient tons. In 1977 the mine flooded and production was abandoned. There are potash reserves in Ethiopia, but because they are poorly located in relation to domestic and export markets, it is unlikely that these will be commercially developed in the foreseeable future.

Blended Fertilizers

Blended fertilizers developed in the North American market and production has spread around the world, but these are not a primary production sources. These products use solid finished fertilizer materials such as urea, diammonium phosphate, and muriate of potash blended to form various grades of NP, PK, and NPK fertilizers. Blending plants have been established in SSA notably in Nigeria, Malawi, Kenya, and Zambia. Blending is basically a marketing operation. In the United States, bulk blending developed in response to two factors: (a) market demand location and (b) soil testing. The main Midwest market is located away from the main manufacturing sources; nitrogen on the Gulf Coast, phosphate in Florida, and potash in New Mexico and Canada. Medium-sized regional granulation plants (100,000 to 200,000 tons annual capacity), which have declined from more than 130 to less than 20, had to bring raw materials to a central location, process them, and then distribute the finished NPK fertilizers over fairly large regional market areas. Small bulk blending plants allowed retailers to bring in finished products in bulk and distribute prescription bulk blends in local market areas. These bulk-blending plants average about 5,000 tons in annual sales and distribute and apply the bulk-blended product directly to farms within a 50-km radius. By using soil testing, retailers are able to blend fertilizers to suit the requirements of individual fields and crops. With the advent of information and communications technology and global positioning technology, this approach has been further refined to “precision farming” where variable application rates of N, P, and K can be matched to variable soil fertility levels and crop yield potentials within large fields.

Blended fertilizer use in SSA is simply an alternative to providing complex NPK fertilizers. The products have to be bagged for distribution and use, and there may be a cost saving in sourcing raw materials, compared with complex fertilizers, and blending them at the country level. The quality of blended fertilizers is highly dependent on the quality and size matching of the component materials and on the operation and maintenance of blending equipment. Without adequate regulations and enforcement, the risk of under-analysis or incorrect analysis may be prevalent.

NP and NPK Complex Fertilizers

Europe developed a large nitro-phosphate production capability based on PR and nitric acid derived from ammonia. This production process eliminates the need for both sulfuric and phosphoric acid and enables production of complex fertilizers that contain nitrogen and P or nitrogen, P, and potassium. World-scale plants in Europe are the source of much of the complex fertilizers containing NPK and micronutrients that are imported into Africa.

Fluid Fertilizers

Fluid fertilizers offer some advantages over solid fertilizers but require significant investment in storage, distribution, and application equipment. Use in SSA is confined to specialized drip irrigation for very high-value crops.

Direct Application of Phosphate Rock

Numerous studies have been conducted to determine if indigenous PR deposits in SSA can be used as sources of P to improve soil fertility and crop production. The key to successful use of direct application PR is high reactivity of the PR, high soil acidity, and the location of the mine near the market. Without these characteristics its use is ineffective or uneconomic as a phosphate source. It is most efficiently used on long-term tree crops. Due to the low analysis and bulky nature, economic use is restricted to within a relatively small radius of the source.

In Mali, a medium-reactive Tilemsi Valley PR has been found to be suitable for direct application to acid soils for cotton, maize, rice, millet, and sorghum. The entire production of PR is used within the country and increased from 4,529 tons in 1981 to 9,835 tons in 1990. The mine operated sporadically in the early 1990s as a result of political unrest in the mining area. Although production was revamped starting in 1994, national production has never exceeded 7,000 tons/year (tpy). The estimated potential production capacity is 36,000 tpy.

A large reserve of PR with a low-to-medium reactivity is located in Sokoto State in northern Nigeria. Studies have shown it to be relatively agronomically effective. However, production is currently only about 3,000 tpy using manual mining techniques.

In 1983 a highly reactive Minjingu PR deposit in Tanzania was developed with an initial production of about 20,000 tpy for acidulation in Kenya to single superphosphate, and about 700 tpy was used for direct application. Current production is about 10,000 tpy with most used in Kenya for fertilizer production.

A low-reactive PR from Busumbu in Uganda has been tested for various crops including agroforestry, but commercial use is minor. Togo exports all of its PR production estimated at about 1.7 million tons in 1999. Senegal transforms the indigenous raw material to produce DAP for its local markets and phosphoric acid for export markets.

In Burkina Faso, there is a strong government interest in promoting the use of PR and revamping domestic production. With more than 63 million tons of PR deposits at Kodjari, the government is looking for ways to revamp the Kodjari plant by increasing its production capacity from the current 2,500 tpy to a minimum of 15,000 tpy. This is aimed at supporting the ambitious campaign that the government launched to promote the production and use of PR-based compost. The program that encourages and challenges farmers to achieve the objective of setting up compost pits started with the objective of 50,000 pits in 2001. It has now reached a total 200,000 pits.

4. Global and African Fertilizer Trade

Table 4.1 summarizes net trade (imports minus exports) by global regions and illustrates the dependence of Asia, Latin America, Oceania, and western Europe on fertilizer imports from North America for phosphate and potash, and from Eurasia for all three primary plant nutrients. Africa has a substantial net export of phosphate and a small net export of nitrogen, but this reflects the export situation in North Africa as shown in Table 4.2. The trend in exports from SSA is depicted in Figure 4.1. The closure of the NAFCON 1 ammonia/urea plant in 1997 reduced fertilizer exports by 100,000 tons, and other exports from Tanzania, Zambia, and Zimbabwe are negligible amounts. Senegal exports phosphoric acid for fertilizer manufacture and Togo exports phosphate rock with little or no value addition. Recent studies (IFDC 2004a) provide a compelling case for reopening the NAFCON plant in Nigeria, but output is expected to be used domestically. There is interest in building an ammonia/urea plant in Angola and if they proceed, it will be export-oriented due to the completely under-developed Angolan market.[4]

Table 4.1 World: Fertilizer Net Imports by Regions, 2002/2003

Region	2002/2003			
	N	P_2O_5	K_2O	Total
	('000 nutrient tons)			
North America	4,231	-3,649	-3,982	-3,401
Western Europe	1,544	1,454	-135	2,864
Oceania	788	602	463	1,853
Eastern Europe	-578	-110	667	-22
Eurasia	-6,722	-2,381	-6,922	-16,026
Africa	-88	-1,555	568	-1,074
Latin America	2,577	2,367	3,235	8,179
Asia	2,126	3,712	4,699	10,537
World	3,876	440	-1,407	2,910

Source: Derived from FAO data.

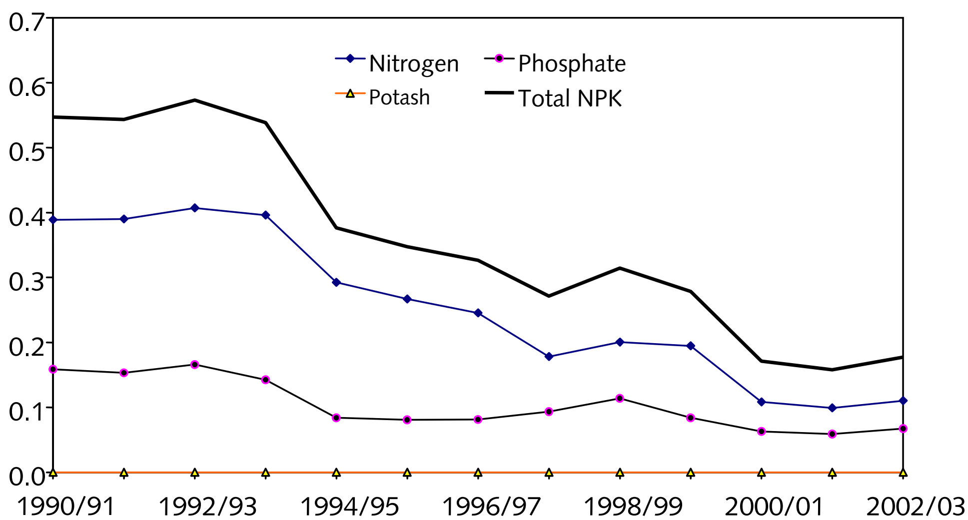
Note: Net Imports = Imports – Exports.

Table 4.2 Fertilizer Trade in Africa by Sub-Regions, 2002/2003

Sub-Region	Imports				Exports				Net Imports			
	N	P_2O_5	K_2O	Total	N	P_2O_5	K_2O	Total	N	P_2O_5	K_2O	Total
	('000 nutrient tons)											
North Africa	301	66	156	522	1,399	2,000	0	3,399	-1,098	-1,935	156	-2,877
Sub-Saharan Africa	709	411	288	1,408	43	18	35	96	666	393	253	1,312
South Africa	395	74	188	658	51	87	29	167	344	-13	159	491
Total Africa	1,405	551	633	2,589	1,493	2,105	64	3,663	-88	-1,555	568	-1,074

Source: Derived from FAO data.

Figure 4.1 Sub-Saharan Africa: Nitrogen, Phosphate, Potash, and Total NPK Exports, 1990/1991–2002/2003

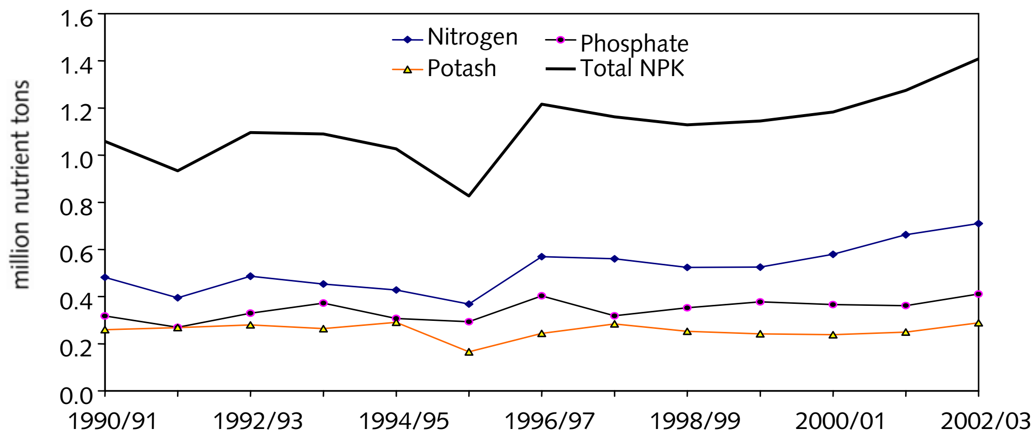


Source: Derived from FAO data.

Imports of fertilizer nutrients in SSA show an increasing trend from 1995/96 (See figure 4.2). However, this reflects the increased imports of urea to Nigeria to replace the lost domestic production from the NAFCON plant. There has been no significant change in phosphate and potash imports during the past decade.

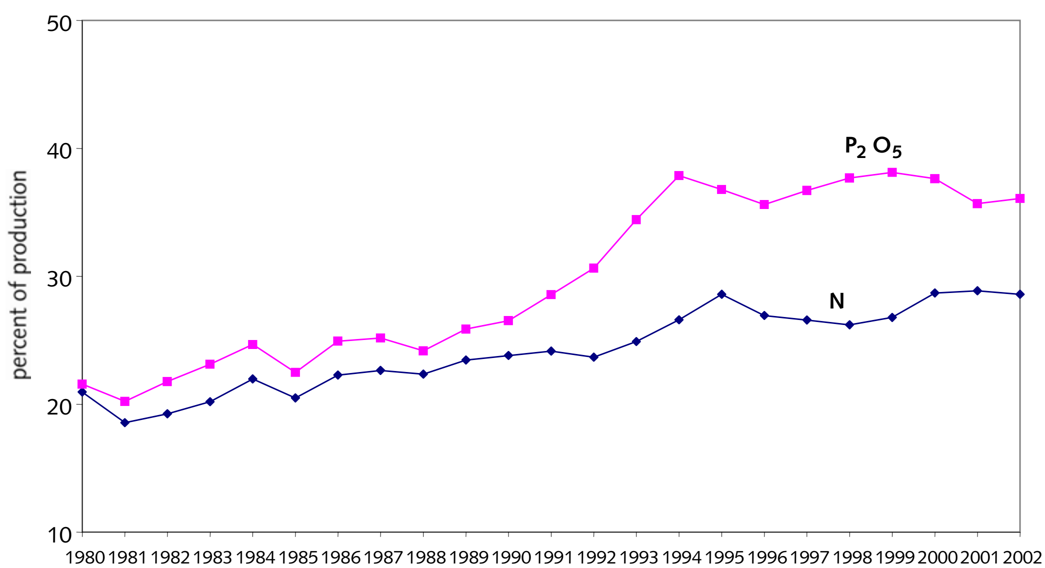
SSA essentially relies on imported fertilizers for supply. This is not inherently a disadvantage because there are ample supplies of fertilizers in an increasingly internationally traded market. The increased trade in nitrogen and phosphate fertilizers is depicted in Figure 4.3. Nitrogen fertilizers traded as a percentage of global production increased by 50%—from 20% to almost 30% during the past two decades—and phosphate fertilizer trade doubled to 40% of global production.

Figure 4.2 Sub-Saharan Africa: Nitrogen, Phosphate, Potash, and Total NPK Imports, 1990/1991–2002/2003



Source: Derived from FAO data.

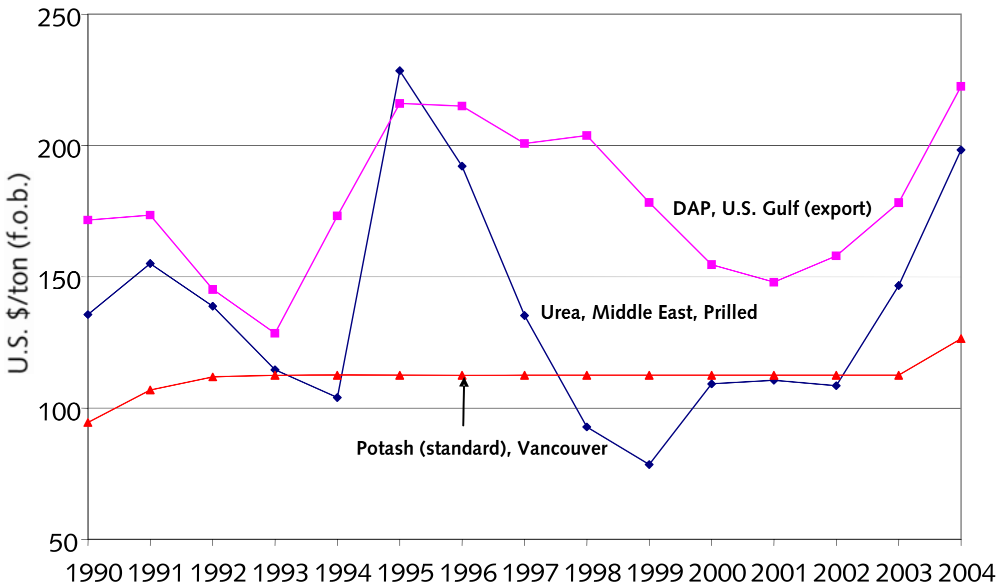
Figure 4.3 World: N and P_2O_5 Exports as a Percentage of Production, 1980/1981 – 2002/2003



Source: Derived from FAO data.

The disadvantage of countries relying on imported fertilizer is not access to supply but the variability in international prices and price instability caused by devaluation of local currencies. The cyclical nature of international nitrogen and phosphate prices is illustrated in Figure 4.4. The concentration of the potash industry in a very few firms and over capacity in mining has helped avoid cyclical movement in potash prices. Fertilizer prices rather than quantities

Figure 4.4 Yearly Averages of Fertilizer Prices, 1990–2004



Source: *Green Markets*, various issues.

assume the primary burden of adjustment toward market equilibrium and the industry suffers from relatively large price fluctuations over time. Furthermore, because of the limited scope for adjusting supply capacity in the short term, the rate of capacity utilization in existing facilities assumes part of the burden for output adjustment. Investment in both nitrogen and phosphate plants is "lumpy" (Gregory 2002) due to the large investments required; the large increases in capacity that are generated from the investments in competitive world-scale plants; and the time lag between investment decisions and operation of new facilities. These investment decisions are made in response to increasing global demands that outstrip installed capacity resulting in increased international prices and attractive returns for new investments. When several independent investment decisions occur, the new capacity outstrips demand and international prices fall.

5. Factors Affecting Fertilizer Supply in Africa

African countries have made substantial progress in liberalizing and deregulating their fertilizer markets although pockets of interventions and unpredictable involvement by government or donor agencies still exist. For example, in Nigeria, the Federal Government continues to provide a subsidy to a small segment of the farming population, and the Government of Zambia plays a key role in distributing fertilizers to targeted farmers. In Malawi both government and donors become involved in the free or subsidized distribution of inputs—seeds and fertilizers. Nevertheless, the role of crop marketing boards and other state-owned entities in the marketing and distribution of fertilizers has been eliminated or reduced, and the private sector has been allowed to import and market fertilizers at all levels of the supply chain—import, wholesale, and retail. It was anticipated that these policy reforms would encourage the development of well-functioning fertilizer markets and increase agricultural intensification, particularly among smallholder farmers growing food crops. Although there has been a marked increase in the number of private firms involved in the marketing of agricultural inputs, these emerging input markets remain underdeveloped and fragmented, and access to inputs is a challenge for smallholder farmers in rural areas.

Constraints Affecting the Performance of Fertilizer Markets[5]

Constraints affecting the performance of fertilizer markets could be broadly divided into three groups:

1. Market Development.
2. Technical.
3. Infrastructural.

Market Development Constraints

Well-functioning markets need an enabling policy environment, adequate human capital (embodied in marketing, financial, and technical skills), easy access to finance and market information, and effective enforcement of regulatory systems. In contrast, in spite of policy reforms, the policy environment remains uncertain, human capital is inadequate, access to finance and market information is limited, and the enforcement of regulations is ineffective in many countries, including Madagascar, Malawi, Zambia, Nigeria, and Mali. As a result, fertilizer markets are constrained and operate at sub-optimal levels.

Uncertain Policy Environment

Through liberalization and privatization efforts, many countries have removed price and marketing controls and the private sector has made significant inroads. However, there is a lingering fear in the minds of policy makers that the private sector is not capable of supplying inputs in a cost-effective manner, and therefore, the government should intervene directly in the marketplace. In Zambia in 2003, the government bought 48,000 tons of fertilizers (out of 120,000 tons of total use in the country) and distributed that to targeted farmers at one-half price. Similarly, the government in Malawi, with support from donors, distributed free inputs to selected poor farmers. In 2003, the Government of Tanzania announced that it would supply subsidized fertilizers to selected areas in the country. In 1999, the Government of Nigeria announced a 25% subsidy on all fertilizers and forced the private sector to deliver fertilizers at the local government depot. Payments for such deliveries were not made promptly, and as a result, the private sector reduced imports for the next year. Once the farmers know that there is a subsidy, they justifiably refuse to buy fertilizers at the full price, and the fertilizer dealer has to incur losses in carryover stocks for a year because fertilizer use is seasonal. Such pronouncements not only produce an adverse impact at the micro level (dealers) but also affect import planning at the macro level. The 2003 situation in Tanzania illustrates this point well. Because the local dealers were not able to sell their product in late 2003 and early 2004, they did not order supplies from the wholesalers and importers, and importers did not import adequate fertilizers needed for topdressing of the spring crop. By the time the government finalized its plan, it was too late to get an adequate and timely supply of fertilizers in the country. Likewise, the Government of Madagascar announced in 2004 that it would import fertilizers for direct distribution. Naturally, the private sector did not import sufficient fertilizers, and the government could not get funding to import fertilizers, thus farmers suffered from the fertilizer shortages. Not only did the governments send wrong signals but also the donors and non-governmental organizations (NGOs) contributed to the uncertain policy environment by distributing free inputs. Fertilizers received under Kennedy Round 2 (KRII) have also created problems for the private sector in Uganda, Tanzania, Mozambique, and Madagascar. Fertilizers under KRII are required to be sold at one-half free on board (f.o.b.) price, which is significantly lower than the price charged for commercial imports. Any dealer who can obtain KRII fertilizers can easily out bid the other dealers who are selling fertilizers at full prices. KRII fertilizers should be properly integrated with commercial imports. Thus, the policy environment faced by the private sector remains uncertain in many countries.

Inadequate Human Capital

The quantity and the quality of human capital involved in the fertilizer business are limited. Quantity refers to the number of input dealers available in the country, especially in the rural areas, and the quality refers to the marketing and technical skills of the people involved in the input business. The limited number of qualified input dealers in the countryside is reflected in the fact that it is easier to find "Coca Cola" than seed or fertilizer in an African village.

A developed input marketing system is served by an extensive dealer network into the rural interior, which makes inputs available to farmers at affordable prices and in a timely manner. Although in some countries, such as Kenya, there are more than 3,000 input dealers, in many other countries (Malawi, Zambia, Nigeria, Uganda, Ethiopia, and Madagascar), the number of dealers serving the farming population is limited. In Uganda, there were less than 100 input dealers in the country and few in the rural areas in 2001. Even in Tanzania, there were only 500 input dealers in 2003. Moreover, many of these dealers are concentrated in urban or semi-urban areas. Therefore, there is a scarcity of dealers in the rural interior near smallholder farms. As a result, farmers must travel 20–30 km to purchase fertilizer, seeds, and other inputs. This raises the cost of inputs to farmers, either limiting the quantities they can afford to purchase or rendering them unable to purchase any inputs at all.

Not only is there a paucity of dealer networks in the countryside but also the marketing and technical skills of input dealers involved in the input business are limited, and their linkages with wholesalers and importers are restricted. Many dealers lack proper knowledge about fertilizer products, their proper use, and storage. It is not uncommon to find retail shops where the dealers have stocked seed, fertilizer, sugar, pesticides, and flour on the same shelf. Because fertilizer is a knowledge-intensive commodity, the lack of technical knowledge on the part of dealers restricts the development of the input business, and not separating pesticides from food items poses serious health risks.

Limited Access to Finance

The fertilizer business is capital intensive, and access to finance is an important determinant of the importers' and dealers' ability to conduct their business activities. The banking sector in African countries has limited outreach in rural areas. High interest rates and stringent collateral requirements make it difficult to access finance for business development. Many commercial banks consider the input business as agriculture and are reluctant to lend for the input business. Generally, they are risk-averse because many of these banks have lost large sums of money in agricultural lending in the past. Poor loan recovery and the lack of mechanisms for contract enforcement in rural areas also discourage the commercial banks from venturing into input business lending. Importers and dealers find the collateral and other lending terms unattractive given the seasonality of agriculture, the relatively low returns from the inputs business, and the high level of risk due to the vagaries of the weather. Loans provided by microfinance banks are inadequate for business development. For example, in Tanzania, microfinance banks lend $50 to $500, which is adequate for only 3–30 bags (of 50 kg each). A dealer selling approximately 1,000 tons of fertilizer products may need $300,000 or more. It must be stressed that many commercial banks in African countries have liquidity with them but are reluctant to advance loans to input dealers. Innovative mechanisms are needed to induce banks to lend for agribusiness development.

Lack of Market Information

Market information is important for market development because it creates market transparency and information flows. This enables planning and reduces transaction costs, which facilitates long-distance trade. Although some countries have started developing market information systems, their coverage is inadequate on prices and availability in different market segments; and due to limited resources, dissemination is weak. In many countries, the information about regional and global fertilizer markets with importers and wholesalers is limited. The lack of an effective market information system poses a hindrance to the development of well-functioning input markets. Inadequate information makes it difficult (a) for the government and the private sector to plan ahead to address shortfalls or carryover stocks in the next season; (b) for the private sector to keep abreast of market requirements and shortages in different parts of the country and plan their marketing strategy accordingly to meet farmers' needs and maximize their returns; and (c) for market participants to be aware of the current market situation beyond their immediate geographic area.

Weak Regulatory Systems

In a private sector-led input marketing system, one of the critical roles of government is to protect the interests of consumers and the general public by formulating and enforcing a legal and regulatory framework regarding quality, standards and measures, safety in use and disposal of inputs, and business ethics. In Tanzania, no regulatory framework exists for fertilizers.[6] In other countries, where fertilizer laws exist, the enforcement of those laws is inadequate. In 2000, Nigeria faced a serious problem of adulteration and mislabeling of products. Mixtures of sand and urea were sold in NAFCON bags (IFDC et al., 2001). In that same year, in Malawi, more than 1 million liters (L) of outdated pesticides were available for sale in retail shops. Many retailers sell fertilizers from open bags in small quantities of 1, 2, or 5 kg. Because fertilizers are hygroscopic, such practice can lead to caking and reduced usefulness of fertilizers. Although there is no quality problem with straight products in Tanzania, Zambia, or Malawi, there is a danger of poor quality with NPK mixtures or blended products. Proper checking and regulation is needed to ensure truth-in-labeling and quality at the point of sale. A comprehensive regulatory system is required at the country level.

Size of the Market

It was mentioned earlier that SSA accounts for less than 1% of the global fertilizer market, and at the country level, the size of the market is even smaller. More than one-half of the countries use less than 10,000 nutrient tons and more than 80% use less than 50,000 nutrient tons (See table 1.3). Additionally, these countries use several different products: urea, ammonium sulfate, CAN, TSP, DAP, MOP, NPKs, (15-15-15, 14-28-14, 20-20-0, 25-5-5, and others), Compound D (in southern Africa), cotton formula (western Africa), and a large number of other compounds. Most of these products are imported. Because of economies of scale in production and procurement, countries using small quantities of these products pay higher prices for both product and shipping. In 1999, importers in Uganda were importing in small parcels of 500–1,000 tons each of various products at high prices, and farmers were paying more than $600/ton for urea when urea was sold for less than $100/ton on the global market. Such a high price was the result of both an underdeveloped fertilizer market and small quantities procured in the global market. When Ugandan importers were advised to piggyback their import orders with large importers in Kenya, the retail price of urea dropped to more than $300/ton.

Unnecessary Product Differentiation

Not only is the size of the fertilizer market small at the country level, but even that small size market has been fragmented into many products. For example, in 2000, Malawi was using more than 20 products for a market size of more than

200,000 product tons (See table 5.1). Many of these special compounds must be produced for a country-specific market at a high cost. From an agronomic point of view, such fine differentiation between compounds B and C (2% N difference) is unnecessary because plants do not need such specific N applications. Plants need nutrients, not the "freedom of products." Another example comes from West Africa where different countries procure tailor-made cotton formulas, artificially differentiated in nutrient contents (See table 5.2). Because these products are not traded globally, production costs of such products are high. It should be noted from Table 5.2 that all countries except Togo and Cote d'Ivoire use the cotton formula containing 14%-15% N, 20%-24% P_2O_5, 12%-15% K_2O, 5%-7% sulfur, and 1% boron. By harmonizing their cotton formula, these countries can create a large market for this product and benefit from economies of scale in production and procurement, without compromising the nutrient needs of plants.

Table 5.1 Fertilizer Products Marketed (% Nutrient)

Products	N	P_2O_5	K_2O	S	B
	(%)				
Urea	46	0	0	0	0
CAN	27	0	0	0	0
AS	21	0	0	24	0
AN	34	0	0	0	0
DAP	18	46	0	0	0
SSP	0	18	0	0	0
TSP	0	46	0	0	0
MOP	0	0	60	0	0
SOP	0	0	50	0	0
23-21-0+4S	23	21	0	4	0
Compound B	4	15	18	0	0
Compound C	6	15	18	0	0
Compound D	8	18	15	6	0
Compound J	15	5	20	3	0.1
Compound S	6	17	6	3	0.1
Compound 3D	20	10	5	3	0
Compound 321	12	19	5	3	0
Compound Super B	5.4	20	24	6	0.1
Compound Super C	8	20	24	6	0.1
Compound Super D	10.5	20	24	6	0.1

Source: IFDC et al. (2002a).

Table 5.2 Dominant Cotton Formulas Used in West Africa

Country	Company	Formula $N-P_2O_5-K_2O-S-B$	Year	Use
				(tons)
Mali	CMDT	14-22-12-7-1	1999	63,900
Benin	SONAPRA	14-23-14-5-1	1998	22,700
Niger		14-24-14-5-1	1998	4,000
Burkina Faso	SOFITEX	14-23-14-6-1	1996	30,000
Togo	SOTOCO	12-20-18-5-1	1999	20,000
Cameroon	SODECOTON	15-20-15-6-1	1999	13,800
Côte d'Ivoire	CIDT	15-15-15-6-1		

Source: Compiled from different sources in 2000. See IFDC 2001.

Technical Constraints

Sound technical knowledge of fertilizer products on the part of farmers is essential to promote the adequate and timely supply of fertilizers in the countryside. Poor farmer knowledge regarding the correct use of agricultural inputs is a serious problem. Smallholder farmers growing food crops in Tanzania primarily use topdressing fertilizer; very few use basal fertilizers due to knowledge and economic constraints. Some farmers use a mixture of DAP and CAN for topdressing crops in Tanzania, but such a practice leads to a waste of resources because topdressed DAP provides little benefit. There is a need to update the fertilizer recommendations and make them more appropriate to the different agro-ecological zones and input and output market realities faced by farmers. In Zambia, there is a need to develop proper lime and fertilizer recommendations for acidic soils. In many countries, fertilizer recommendations are based on the fertilizer trials conducted in the 1970s or early 1980s. With changes in cropping patterns, crop mixtures, and continuous cropping, there is a need to develop better fertilizer recommendations.

The continuous cultivation without proper and adequate use of fertilizers or the use of N for topdressing without basal application of NPK fertilizers is leading to soil infertility and degradation problems. As a result, in some areas P deficiency is so acute that a small dose of phosphate fertilizers or Minjingu PR (in East Africa) can lead to increased crop yields. This lack of P has been confused with soil acidity and lime application. New soil tests and fertilizer trials are needed to establish proper recommendations for fertilizers and lime, if necessary.

Infrastructural Constraints

In many countries, such as Zambia, Tanzania, Ghana, and Nigeria, main highways and inter-city roads are well maintained, but feeder roads linking main cities to other areas are in poor condition, and add to transportation costs and make inputs costly. Improvement in rural road networks is essential to promote social and agricultural development and reduce transaction costs. Only through well-maintained roads can the isolation of rural areas be eliminated. In this context, the work done by the USAID-funded Rural Road Project (1998–2003) in Tanzania on building gravel roads in the Big Four regions (Iringa, Mbeya, Rukwa, and Ruvuma) is noteworthy. Under this program, 1,175 km of roads have been built in 18 districts at an average cost of Tsh 8.4 million per kilometer (IFDC 2004). These road networks seem to have helped in linking rural communities to towns and market centers and have generated significant benefits for the communities in terms of increased production and incomes. However, in other parts of the country, especially western Tanzania, rural roads are in very poor condition. Improvement of rural roads, though a long-term activity, is essential for socioeconomic development.

Physical insecurity in rural areas also discourages the development of input business. Many input dealers, especially those operating input businesses in cities and district towns in Nigeria, Malawi, and Zambia reported that they were afraid to open a store in the village because leaving fertilizer stocks there was not safe. The lack of covered railway wagons on the Tanzania-Zambia Railway Authority (TAZARA) railway line forces dealers to use costly road transport rather than rail routes in Tanzania and Zambia. The lack of banking facilities in the rural areas also discourage the development of fertilizer business because the sale of even 500 tons of fertilizer could generate billions of kwacha or cedis or local shillings in cash and invite the risk of robbery or physical assault.

Landlocked Countries: Not all countries in SSA have access to the coastline. Many countries (such as Mali, Burkina Faso, Uganda, Zambia, Malawi, Congo, Rwanda, and Burundi) are landlocked countries. These countries incur $50/ton to $100/ton for transporting goods from the ports to their borders. The mere geographic location of these countries acts against their farmers because farmers in these countries have to pay higher prices for imported fertilizers and receive lower prices for crop products.

Nothing much can be done to overcome the landlocked nature of these countries. But by developing business linkages with importers in coastal countries, by developing multi-country fertilizer markets, by improving transportation links (especially railways), and by exploring other innovative means, significant improvements could be made in prices and availability of fertilizers. Some of these options are elaborated in Section 8.

6. Conceptual Framework

For most of SSA, there will continue to be reliance on imported mineral fertilizer as a component of the needed productivity inputs required for intensification. Because the supply of products is readily available on the international market, the problem of supply is essentially one of efficiency in procurement, distribution, and marketing. Inefficiencies in these areas and high internal transportation costs, lead to farm-gate prices that are often two to three times international price levels. This often makes the use of mineral fertilizers by smallholder farmers in SSA uneconomic. Investment in transportation infrastructure is a long-term solution to lowering internal transportation costs but cannot completely overcome the costs that are involved in transporting fertilizer vast distances to landlocked countries. However, the removal of constraints and improvements in efficiency can lower costs and improve the effectiveness of the supply systems.

During the 2000–2006 period, IFDC prepared action plans for developing agricultural input markets (AIMs) in Malawi, Nigeria, Ghana, Uganda, Zambia, and Tanzania. These action plans focused on four broad themes:

1. Functioning and performance of AIMs (seed, fertilizer, and crop production products [CPPs]).
2. Constraints affecting the performance of AIMS.
3. Potential of the private sector to supply inputs in a cost-effective and timely manner.
4. Measures needed to strengthen the functioning of private sector-based AIMs.

During this work, it was realized that the concept of SSCR is relatively more suitable for the conditions prevailing in SSA. It is comprehensive and pragmatic and can accommodate conditions prevailing in export and food crop sectors and large and smallholder sectors. Associated with this concept are the five pillars of market development, which are elaborated in Section 8.

Historical Perspective

The agricultural lending experience of the World Bank and other donors in Africa during the 1960s indicated that there was no active private sector to assume responsibility for marketing and investment in the agricultural sector. This experience induced donors to create and support activities of state-owned enterprises (SOEs) in many developing countries. Additionally, when SOEs were created, they were given monopolistic power over marketing and investment in the agricultural sector, and the private sector was barred from marketing agricultural products, especially inputs. However, by the early 1980s, it became clear that many SOEs were not operating efficiently and had become a burden on the national budget. Unsustainable fiscal imbalances and inefficient use of resources by SOEs forced several developing-country governments to move toward privatization of the SOEs. By the early to mid 1990s, many SOEs in the agricultural sector in Africa withdrew from marketing and investment activities or were no longer in a monopolistic position. The private sector was allowed to participate in the marketing of inputs and outputs. However, due to structural constraints, the response from the private sector was slow. Macroeconomic instability leading to devaluation and high interest rate, lack of marketing skills and finance, and inadequate regulatory systems and market transparency continued to limit the active involvement of the private sector in the input business.

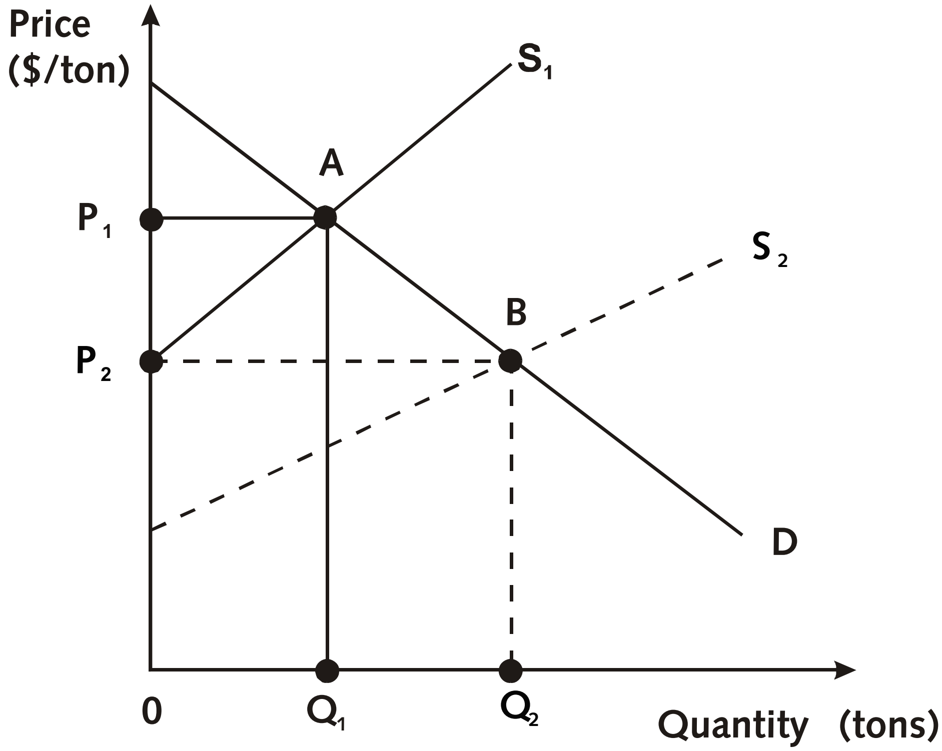
This slow response from the private sector may wrongly convince policy makers and donors to move back to the public sector monopoly in input distribution. Such a move would be premature because it would divert the attention away from removing structural constraints to the private-sector participation. Macroeconomic stability, access to finance, business skills, market information, and regulatory frameworks are still not in place. Many of these constraints have prevented the development of well-functioning input markets in Sub-Saharan Africa in general. Deregulation and liberalization are necessary but not sufficient to encourage the private-sector participation in agricultural markets (IFDC et al. 2002). Years of discrimination and neglect have left the private sector underdeveloped and the input markets fragmented. Rather than returning to the old SOE system, African countries and donors need to invest resources in building the capacity of the private sector and supporting infrastructure.

Shifting the Supply Curve

Figure 6.1 illustrates the typical supply and demand curves used by economists in explaining the behavior of prices in a free (competitive) market situation. On the horizontal axis, quantity of input, for example, fertilizer is measured and on the vertical axis, the price of the same input is measured. The demand curve D slopes downward from left to right indicating that the quantity of fertilizer demanded by farmers' increases as the price of the fertilizer decreases and vice-versa. The supply curve S1 slopes upward from left to right indicating that as the price increases, the quantity of fertilizer supplied increases. At price OP1, quantity demanded equals quantity supplied (OQ1) and therefore, OP1 is referred to as an equilibrium price and point A as an equilibrium point. The price OP1 is very high (e.g., $300/ton of urea) and therefore the quantity traded is low (e.g., 50,000 tons of urea). Since the resource-poor farmers in developing countries cannot afford to purchase fertilizers at such a high price, one possible solution is to provide a subsidy of, for example, $100/ton and reduce the price to $200/ton of urea. Now at this price, the demand outstrips the supply and therefore some mechanism for rationing is required to allocate this limited quantity among all farmers. Such a solution was tried by many African countries but could not be sustained. Also, it introduced distortions in the market and led to an inefficient use of resources.[7]

The position of the supply curve S1 on the vertical axis indicates that the minimum price at which the suppliers are willing to offer any quantity is very high. This is so because the size of the market is small and suppliers incur high

Figure 6.1 Reducing Fertilizer Price by Shifting the Supply Curve to the Right (SSCR)



Source: IFDC et al. (2002).

costs in procuring and shipping small quantities, thereby not benefiting from the economies of scale in procurement and transportation. Also, the suppliers are not procuring their product from the cheapest source in the global market due to various constraints faced in accessing information and finance. Because of these constraints, supply price is generally high. Rather than following the subsidy route, the price of fertilizers could be reduced by shifting the supply curve to the right—from S1 to S2. Such a shift in the supply curve is possible if the economies of scale in procurement and shipping could be realized, the fertilizers could be procured from cheaper sources through better access to information and finance and through improvements in policy environment, human capital, and marketing infrastructure. By shifting the supply curve to the right (point B), the price could be reduced and the quantity of fertilizer used by farmers could be increased, thereby promoting food security at both the household and national levels. Such a move also reduces the need for subsidies and ensures a higher return on the capital invested in business (because under the S2 supply situation, the fixed cost per unit sold is lower). Thus, by shifting the supply curve to the right, benefits could be created for all stakeholders (i.e., farmers, traders, and the country at large).

Can the supply curve for agricultural inputs in general and fertilizers in particular be shifted to the right in SSA countries? Various constraints, mentioned in Section 5, have kept the supply curve at S1 position in SSA countries. The removal of these constraints could help in shifting the supply curve to the right. The activities proposed in the areas of policy reform, human capital development, improved financial services, market information systems, and regulatory frameworks are all geared to shifting the supply curve to the right, thereby helping in reducing transaction costs. These and other measures are elaborated in Section 8.

7. The Fertilizer Supply Chain

Components of the Supply Chain

Various components of the supply chain are described below. The basic functions include production, procurement, distribution, and retailing. In mature supply chains and government-owned systems, there is often vertical integration of these functions although this is not necessary and function differentiation is also common. Within countries, mixed supply chains often exist.

Production Function

The global supply/demand balance for fertilizer is characterized by fluctuating annual demand and long-time lags in supply adjustment that drives the basic economic status of the fertilizer manufacturing industry. This results in periodic significant price adjustments in international prices. The industry has to be considered as a global industry with increasing trade derived from production in regions of least-cost raw materials. Raw materials constitute 70%–90% of cash production costs, and the efficiency with which they are processed is crucial to the operating profitability of firms. Consolidation and concentration of the global production industry continues to occur to optimize the use of least-cost raw materials and offset capital investment costs. The two main costs in fertilizer production are (a) the cost of raw materials (in the short run) and (b) the cost of capital (in the long run). The first variable and the price of fertilizer determine the operating rate of the firm in the short run (i.e., operating capacity utilization). The cost of capital and the production technology efficiency determine the long-run cost structure and capacity of individual firms and the industry.

Most countries in SSA will remain dependent on imported fertilizers for agricultural intensification due to the lack of low-cost raw materials for production, low domestic demand, and therefore capacity utilization, and high capital requirements for investment in world-scale production facilities. Exceptions to this situation include Nigeria, and possibly Angola and Mozambique where there are ample supplies of low-cost natural gas in coastal locations that enable production surplus to domestic market demand to be sold competitively to regional and international markets. Countries in North Africa will continue to expand production of both high-analysis phosphate fertilizers and ammonia/urea/ammonium nitrate directed to international export markets. The Republic of South Africa will continue to produce both phosphate and nitrogen and NPK fertilizers based on ample supplies of PR and coal-based ammonia production and may switch from coal to imported natural gas from Mozambique in the long run.

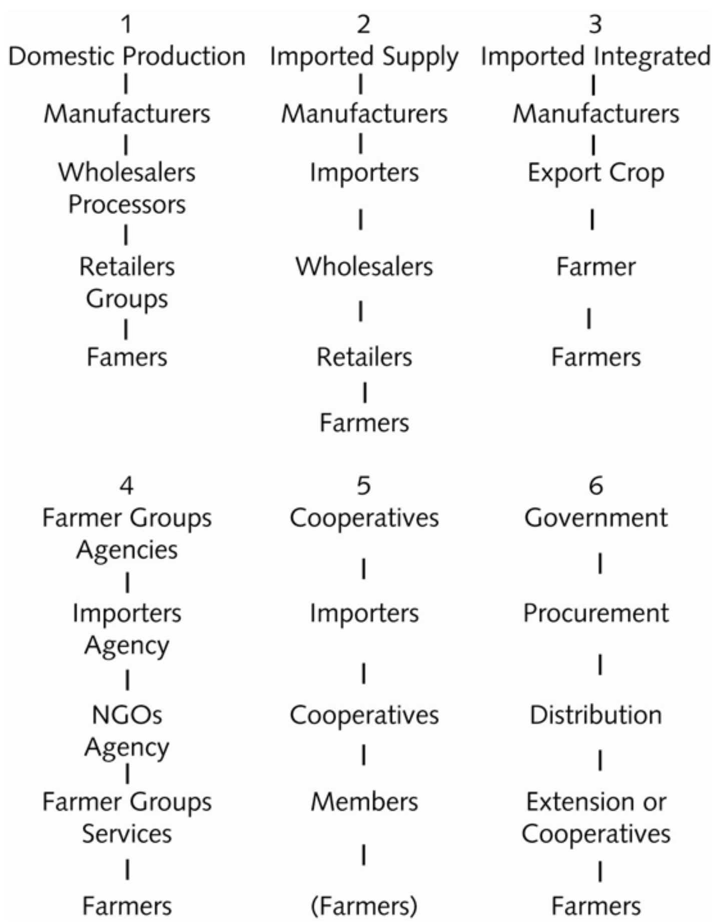
Procurement and Distribution Chains

In well-functioning fertilizer markets an integrated chain of suppliers at all levels—import, wholesale, and retail—serves farmers. However, in many countries in Africa, distribution networks are underdeveloped or non-existent in rural areas. As a result, it is difficult for farmers to access good quality inputs. In many instances, farmers have to travel 30–50 km to buy inputs. Such distances not only add to the cost but also create a psychological barrier against the use of inputs. Development of input dealers in rural areas is essential to improve the access to inputs.

Procurement and distribution/marketing chains can be measured by their effectiveness and efficiency. Effectiveness is the ability of the system to conveniently provide quality and appropriate fertilizers in sufficient quantities to meet market demand. Efficiency is the ability of the systems to be effective at the lowest possible cost.

Supply chain systems in SSA are not usually vertically integrated except where there are still vestiges of public sector systems and for the export cash crop sector. Figure 7.1 illustrates the six main systems found. However, in Ghana, Tanzania, Uganda, Nigeria, Zambia, and Malawi, there are firms that import and distribute to their own retail outlets.

Figure 7.1 Fertilizer Supply Systems in SSA



Source: IFDC various market studies.

Systems 1 and 2 in Figure 7.1 represent mature competitive organizations with differentiation of the main functions, extensive retail market networks, and convenient farmer access to inputs including fertilizer. There are few such systems in SSA.

System 3 is common in the export cash crop sectors of SSA such as cotton in West African countries and Mozambique, tea and coffee in Kenya and Tanzania, tobacco in Uganda and Malawi, and sugarcane in Uganda and Mauritius with vertical and horizontal integration from the export-processing companies. These companies in the absence of developed inputs market systems, procure fertilizer, and other inputs for their contracted growers, supply these under seasonal crop credit conditions, and buy back product for processing and marketing. These are generally effective systems but suffer from the disadvantage that they are generally closed systems that do not provide fertilizer for other market segments, and may not be the most efficient due to lack of competition.

Systems 4 and 5 are common where NGOs are implementing development projects usually in underdeveloped market settings for a relatively small number of farmers, chosen either for reasons of improving food security or for developing some crop commodity comparative advantage.

Several variations exist in these systems. Some NGOs simply procure fertilizer from importers and provide these to the farmer groups either free or under crop credit terms. There are examples of NGOs directly procuring fertilizer from manufacturers for the producer (farmer) groups. Others encourage the formation of producer groups that act as buying groups and some, for example, Cooperative League of the United States of America (CLUSA) in Angola, have established farm service centers that procure fertilizer and other inputs from importers for sale to members and non-members, but members benefit from a discount in prices. Work for fertilizer schemes has been implemented in Angola and Malawi with and without links to private-sector retailers or importers. All of these methods are employed to provide convenient access to fertilizer for farmers targeted in the projects. A common misconception in many of these systems is that producer groups, whether cooperatives or not, can circumvent the costs and margins associated with wholesaling and retailing fertilizer. The main costs of transport and inventory financing cannot be avoided. In the long run, producer groups should concentrate on improving farm production and not divert resources to input procurement and distribution. The most appropriate approach has been to make these interventions market friendly by establishing alternative institutional arrangements that link farmers to input suppliers, financial and business development services, and targeted market outlets.

Cooperative systems may or may not be equivalent to private-sector channels in terms of effectiveness or efficiency. In Ethiopia, membership of cooperatives is a pre-requisite to access credit and input supply, and is hardly conducive to open competitive markets. Throughout SSA government-backed cooperative movements have been fraught with political interference and inefficiencies.

The final System 6 where government agencies take complete responsibility for the supply of fertilizer and other inputs is rapidly disappearing as markets are liberalized. However, vestiges of SOES still exist. In Ethiopia, the Department of

Marketing and Cooperatives is responsible for coordination of imports although it is no longer responsible for actual procurement. In many countries though, government agencies or ministries are responsible for implementing national fertilizer programs, (e.g., targeted input program (TIP) in Malawi and the Fertilizer Support Program (FSP) in Zambia).[8] Implementation of these is still frequently non-market friendly and disruptive to liberalized markets; for example, in Angola and Nigeria where subsidy schemes and donor supply of fertilizer undermines commercial activities. Prior to market liberalization these vertically integrated systems were generally poorly implemented and were neither effective nor efficient with the most frequent faults being pan-territorial pricing and late arrival of fertilizer to meet market demand.

Determination of Demand

Fertilizer has to be conveniently available to farmers in rural areas in sufficient quantities to meet needs at planting times. The time lapse between making a decision to procure fertilizer from the international market and availability in rural areas can be from 2 to 4 months, and even up to 6 months as in Ethiopia. Prior to an import decision, a determination has to be made of the market demand by product. The importance of market information systems to assist in the determination of procurement amounts and types is especially important when there is a lack of integration.

Procurement

Fertilizer procurement from the developed international fertilizer market is a well-developed practice with good institutional arrangements including suppliers, traders, inspection agencies, shipping, and specialized port facilities. All fertilizer trade prices are nominated in U.S. dollars. There are two common commercial procurement practices: (a) procurement by tender and (b) procurement by direct negotiation with suppliers. Both procurement routes are used by the public and the private sectors. Tenders are competitively bid for, and there is adequate and timely information available on international price formation from trade publications in traditional and electronic formats. Product can be purchased in various ways; f.o.b.; cost and freight (c. & f.); cost, insurance, and freight (c.i.f.); and on various other terms. Advantages and disadvantages for these various sales contracts vary depending on the circumstances and the skills and experience of the purchasers. Where there are established trading relationships between buyers and sellers either as independent parties or through joint ventures, there are usually advantages in obtaining very competitive prices and/or some credit facility from the suppliers. There is some evidence that direct negotiation results in a cost saving compared to tendering. This may be as much as 5%, but such a saving is more likely to reflect the volumes being traded.

In SSA countries, procurement is undertaken by both the private sector and governments and often by both sectors within a country. This happens when governments procure on behalf of donors or through government distribution agencies and the private sector imports commercially. These combined efforts of procurement are usually disadvantageous for the private sector due to uncertainty over the level of government procurement; for example, private-sector importers in Madagascar and Tanzania curtail their level of importations due to such uncertainty. Examples exist of government involvement in input procurement through distribution agencies in countries such as Malawi, Tanzania, and Kenya. These procurement procedures are often complex, time consuming, and more significantly, market distorting.

Shipping and Port Handling

Fertilizers are bulky materials and vary in nutrient content. International freight costs are an important consideration in keeping import prices down. Virtually all fertilizer materials can be shipped in bulk at a considerable freight saving over bagged cargo and volume shipped affords economies of scale. The lowest per-unit freight costs are achieved using "panamax vessels," which carry about 50,000 tons of bulk cargo. There are few ports in SSA that can accommodate these large ships, and these are restricted to dedicated wharfs for exporting phosphate rock or other bulk minerals. "Handy size vessels" of 20,000 to 25,000 tons are used frequently for fertilizer shipments, but there are many ports in SSA that cannot accommodate such vessels for bulk unloading. Exceptions include Djibouti, Dar es Salaam, Beira, and Lagos. Smaller vessels of approximately 10,000 tons add to shipping costs by a premium of between 10% and 15% over handy sized vessels. Because African markets require bagged product, a considerable cost saving is realized by bagging bulk cargoes on port arrival. Shipping contracts can be made specifying portable bagging equipment and bags in addition to products. Dispatch rates of 1,000–1,500 tpd can be achieved, discharging directly to portside bagging equipment. Usually it is the availability of trucks for clearing bagged product from the dockside that is the main constraint. It is far more expensive to ship bagged product than bulk, plus the cost of dockside bagging. Bags and bagging costs average between $10 and $15/ton for dockside bagging operations. However, for small markets, bagged product shipments are often used in SSA countries, and the most expensive form of delivery is by containers that hold 20–21 tons.

Other considerations affecting import costs include port charges, inspection fees, discharge costs, agents' fees, bank and finance charges, duties and taxes, clearance fees, and demurrage/dispatch. In congested ports, such as Lagos, Nigeria, it is often difficult to determine in the charter party contract a fair port and discharge time because berthing delays are frequent. When delays occur, demurrage costs can be high—$10,000 to $20,000/day for a 10,000-ton ship, which can add $1–$2/ton for each day's delay. A charter party contract can work in the importers' favor when dispatch is earned for clearing a vessel in less time than contracted usually at 50% of the demurrage rate.

Financing

Most credit programs in SSA have attempted to deal with the credit needs of small farmers, and little attention has been paid to the needs of the importers, wholesalers, and retailers. Three distinctive credit products should be recognized: importer credit, wholesaler credit, and retailer credit.[9]

Imported fertilizer is financed through U.S. dollars—denominated irrevocable letters of credit (LC). Access to foreign exchange is essential. Importers require short-term finance in large amounts. For example, the cost of 25,000 tons of urea at \$200/ton c.i.f. will amount to \$5 million and financing is required for 2–3 months if the product is readily sold to wholesalers on arrival. Established relations and direct negotiation with suppliers can provide access to some supplier credit for short periods, but for the most part importers have to combine self-finance with credit. In many SSA countries LCs may have to be covered by 150% collateral and LC charges can be as high as 2% of the c.i.f. values. Innovative mechanisms are needed to overcome such constraints.

Wholesalers require finance for smaller amounts for shorter periods provided there is access to finance at the retail level, in which case product sales can be cashed in within 1 month. Retailers require even smaller loans but will often require these for several months in order to provide crop production credit to farmers.

Transport and Handling

Internal transport costs are high in SSA because of long transport distances and very poor infrastructure. The poor condition of feeder roads in rural areas adds significantly to the transportation cost of supplying inputs, especially fertilizers, in rural areas. Investment in building and maintaining good roads in rural areas should receive priority in development budgets. Also, in many countries, the main road systems lack maintenance and are subject to many official and unofficial restrictive practices for transportation firms. For example, in Nigeria, truck transport at night is not advised, and there are frequent security check points that delay and increase the cost of transport. To move fertilizer from Lagos to Abuja adds \$50/ton to the cost of fertilizer. The cost of truck transport from Beira in Mozambique to Lilongwe in Malawi was \$60/ton in 2003, adding 43% to the cost of urea ex-Beira. Lack of competition in the trucking sector is often the cause of higher road transport costs and non-availability of trucks can add significantly to transportation costs. The Nacala rail corridor from Nacala port in Mozambique to Lilongwe in Malawi should be more cost efficient than road transport, but current costs are approximately 15% higher than road transport.

Where rail transport is available, attention should be given to strengthening the capacity on its railway lines because, over long distances, railways should be much cheaper than road transport. However, this is often not the case (See table 7.1). In Tanzania from Dar-es-Salaam, the railway line goes in both north/east and south/west directions. However, on both routes the availability of the "covered" wagons is a serious problem. Transporting fertilizers in an "uncovered wagon" poses the risk of insecurity and losses by theft and pilferage. Such risk discourages the dealers from using railways for shipping inputs and forces them to rely on costly road transport.

Table 7.1 Transport Costs in Madagascar, 2005

Route	Distance (km)	Type of Road		Time		Cost FMG/kg	
		Tarmac All-Weather Road	Dirt Road (Difficult Passage During Rainy Season)	Wet Season	Dry Season (h)	Truck	Rail
Tana – Suburbs	10	Yes				100	
Tana – Tamatave	360	Yes		12 hours	12	150	210
Tana – Antsirabe	168	Yes		4 hours	4	70	245
Tana – Mahajanga	600	Yes				750	
Tamatave – Lac Alaotra	400		Yes	2–3 days	24	200	250
Tana – Fiarantsoa	400	Yes		10–12 hours	10–12	125	

Source: IFDC (2005).

Note: Exchange rate: US$1=FMG 9,400.00.

Expensive transportation costs are a detriment to establishing retail market networks because wholesalers are reluctant to transport product to rural retailers where uncertain demand, due to poor seasonal conditions, or lack of purchasing power can result in inventories being carried over to the next season with possible product deterioration. As mentioned earlier, inventory security in rural areas is another constraint to the establishment of retail market networks.

Bagging

There are standard bag specifications for fertilizers. The normal bag size is 50 kg, and materials used are woven polyethylene with a polypropylene liner and polypropylene. Factory bags and bagging costs, average between $10 and $12/ton. Dockside bagging with portable bagging equipment and low labor costs can be competitive with factory bagging; however, these costs can sometimes outweigh the benefits of bulk ocean freight rates as seen in Nigeria where on-shore bagging costs in 2003 were more than $15/ton.

Fifty-kilogram bags are suitable for most commercial and small farmers, but for small gardens and very resource-poor farmers, small bags of 5-kg, 10-kg, or 25-kg are more suitable. In Zambia, Nigeria, and Malawi, retailers are charging a 14%–15% premium for these small packs. While providing value addition for the retailers and convenience for small farmers, the practice adds to already high retail prices.

Efficiency and Effectiveness of SSA Fertilizer Supply Systems

The regional and national environment variability in SSA means that it is not possible to use a single template for measuring the efficiency of current market supply systems. A comparison is therefore presented of four different market circumstances:

- Large markets in coastal countries (e.g., Nigeria - 600,000 tons).
- Small markets in coastal countries (e.g., Angola - 20,000 tons).
- Medium markets in land-locked countries (e.g., Malawi - 260,000 tons).
- Small markets in land-locked countries (e.g., Zambia - 120,000 tons).

These templates are developed by reference to Nigeria, Angola, Malawi, and Zambia. They are derived from data collected by IFDC in 2003 and 2004. Table 7.2 compares the importation, bagging, and delivery costs to retail outlets, and provides a comparison to costs of importing bulk urea for markets in the Midwestern states of the United States.

There is little difference in c.i.f. costs for urea between the United States and the three SSA examples other than the difference in bagged versus bulk product f.o.b. prices.[10] The supply of urea to the Midwestern states in the United States is characterized by very low inland transport costs and low transaction costs in a highly competitive market. It is also characterized by being a bulk product market and a retail market where product is priced applied to farmers' fields. The retail markup of about 15% is due to the service cost element of the application services.

In Nigeria the template refers to importing bulk urea to Lagos, bagging at the port, transporting to central Nigeria by truck to wholesale warehouses, and further distribution by truck to retailers. Excessive port, discharge, bagging costs, and warehousing costs at Lagos Port arise from many factors which include port congestion, a plethora of official and unofficial dues and taxes, delivery to warehouses, and high labor charges. In total these represent more than 11.6% of the retail price. Nigeria has the largest market in SSA, currently about 600,000 tpy of which 60% is urea and shipments are ordered in lots of 15,000 to 25,000 tons. Inland transport in this large country is expensive—at \$40–\$50/ton from Lagos to Abuja, a distance of 400 miles, and equivalent to \$0.125/ton mile. This represents almost 15% of the retail price.

Imports into Malawi and Zambia are based on entry of bagged urea from the Middle East through Beira Port in Mozambique with truck transport to Lilongwe, and rail and truck transport to Lusaka for 10,000-ton shipments. Port costs in Beira are much lower than in Lagos; these costs average 4% of the retail price for transshipment to trucks and 6.8% for transshipment to rail. Transport costs to these inland markets are high and account for 18%–22% of the retail price. Per ton-mile costs vary between \$0.08 for main roads and \$0.12 for local roads. Discussions commenced in 2004 between the Governments of Malawi and Mozambique to improve the operating efficiency and lower costs on the Nacala rail line. This has the potential to lower overall railway freight rates to Lilongwe.

As seen in Table 7.2, the ratio of wholesale price to the c.i.f. price varies from 1.2 in the United States to 1.75 in Nigeria, 1.65 in Zambia, and 1.55 in Malawi. For land-locked countries, Malawi and Zambia, the true c.i.f. cost is approximately the wholesale cost in Lilongwe and Lusaka. For comparative purposes the c.i.f. at

Table 7.2 Comparison of Fertilizer Procurement and Distribution and Marketing Costs, 2003 (US$/ton)

Country	USA			Nigeria			Malawi			Zambia			Angola		
Cost Items and Margins		**Cumm.**	**Margin %**		**Cumm.**	**Margin %**		**Cumm.**	**Margin %**		**Cumm.**	**Margin %**		**Cumm.**	**Margin %**
f.o.b. cost	135.00			135.00			145.00			145.00			226.00		
Ocean freight	25.00	160.00		30.00	165.00		25.00	170.00		25.00	170.00		95.00	321.00	
Insurance	0.08	160.08		0.10	165.10		0.10	170.10		0.10	170.10		2.00	323.00	
c.i.f. cost and % of retail price		**160.08**	**70.64**		**165.10**	**49.12**		**170.10**	**52.94**		**170.10**	**51.03**		**323.00**	**39.00**
LC cost	0.80	160.88		1.65	166.75		1.70	171.80		1.70	171.80		3.23	362.23	
Port costs and transfer inland	4.00	164.88		21.70	188.45		7.82	179.62		17.50	189.30		98.00	424.23	
Duties	0.00	164.88		12.04	200.49		1.63	181.25		1.63	190.93		48.00	472.23	
Losses	1.65	166.53		3.77	204.26		1.80	183.05		1.89	192.83		0.00	472.23	
Bags and bagging	0.00	166.53		15.69	219.95		0.00	183.05		0.00	192.83		0.00	472.23	
Free on barge/truck		**166.53**	**2.85**		**219.95**	**16.32**		**183.05**	**4.03**		**192.83**	**6.82**		**472.23**	**18.02**
Barge/truck transport	10.00	176.53	4.41	50.00	269.95	14.87	60.00	243.05	18.67	72.00	264.83	21.60	5.00	477.23	0.60
Barge/truck unloading	4.00	180.53		0.50	270.45		0.50	243.55		0.50	265.33		0.50	477.73	
Storage and truck loading	10.00	190.53		1.00	271.45		7.29	250.84		1.50	266.83		3.00	480.73	
Interest	2.22	192.75		16.97	288.41		12.54	263.38		13.00	279.83		30.05	510.78	
Wholesale cost		192.75			288.41			263.38			279.83			510.78	
Importer	3.86	196.61	2.00	31.73	320.14	11.00	39.51	302.89	15.00	28.84	308.67	10.31	97.50	608.28	19.09

Table 7.2 Comparison of Fertilizer Procurement and Distribution and Marketing Costs, 2003 (US$/ton)

Country	USA			Nigeria			Malawi			Zambia			Angola		
Cost Items and Margins		**Cumm.**	**Margin %**		**Cumm.**	**Margin %**		**Cumm.**	**Margin %**		**Cumm.**	**Margin %**		**Cumm.**	**Margin %**
margin															
Wholesale price		**196.61**	**86.76**		**320.14**	**95.24**		**302.89**	**94.26**		**308.67**	**92.59**		**608.28**	**73.44**
Dealer costs and margin	30.00	226.61	15.26	16.01	336.15	5.00	18.44	321.33	6.09	24.69	333.36	8.00	220.00	828.28	36.17
Farmer price	**226.61**			**336.15**			**321.33**			**333.36**			**828.28**		
Ratio of wholesale price to c.i.f.		**1.20**			**1.75**			**1.55**			**1.65**			**1.58**	
Ratio of retail price to c.i.f.		**1.42**			**2.04**			**1.89**			**1.96**			**2.56**	

Sources: [a] Estimated from US industry sources by IFDC; [b] IFDC DAIMINA Project reports 2004; [c] IFDC AIMS Project reports, 2004; [d] IFDC An Action Plan for developing Agri-Input Markets in Zambia, 2004; [e] IFDC An Assessment for Improving Fertilizer Supply and Use in Angola and an Evaluation for Phosphate Rock and Nitrogen Production, 2005

Notes: 1. United States: Bulk urea imported, transferred to barge, and delivered to a Midwest location.

2. Nigeria: Bulk urea imported to Lagos, bagged at port, and delivered to retail outlets in Federal Capital Territory (Abuja).
3. Malawi: Bagged urea imported through Beira Port, Mozambique, and trucked to Lilongwe, Malawi.
4. Zambia: Bagged urea from Mid-East port imported through Beira Port, Mozambique, and railed to Lusaka.
5. Angola: Bagged 12-24-12 from Portugal by 20-ft container to Luanda and delivered to Huambo by truck.
6. All urea f.o.b. prices standardized for comparative purposes with a $10/mt difference in bulk and bagged prices.
7. The c.i.f. cost used for land-locked countries (Malawi and Zambia) is based at the first port of entry. The actual c.i.f. is approximately equal to the wholesale cost.
8. The Angola data are for NPK 12-24-12 and therefore are not comparable with data for urea for other countries in the table.

the entry port is used for them. This ratio measures the efficiency of the import and wholesale transaction costs. Due to the high transport costs in land-locked markets and large SSA countries, there is no way to expect reductions down to U.S. ratio levels. However, there is evidence that increased competition will reduce these transaction costs. For example, in Malawi IFDC (2004b) has reported that during the past 3 years the ratio of retail price to f.o.b. price decreased from 2.7 in 2002 to 1.58 in 2003 and 1.53 in 2004 as a result of lower importer and retail margins and improved efficiency in procurement, distribution, retailing, and volumes.

The ratio of retail price to c.i.f. cost varies between 1.9 and 2.0 for Nigeria, Malawi, and Zambia. This approximate doubling of the c.i.f. cost can be reduced through increased volumes and competition in importing to reduce the importer/wholesaler margins from between 10% and 15% down to 5% or less. Retail margin targets should be in the order of 5% or less, depending on the level of service provided.

Angola represents a very small undeveloped fertilizer market with no established fertilizer retail network and uncertainty created by a lack of defined government policies on subsidized donor fertilizer. There were five active fertilizer importers in Angola in 2004—two in Lobito and three in Luanda, importing 1,000–3,000 tons or more annually.

Importers mainly import NPKs (particularly 12-24-12), urea and AS, although in 2004 the first consignment of DAP was imported into Angola. Importers source their fertilizers from the Republic of South Africa, Belgium, Portugal, and Brazil, and they import fertilizer consignments that range in size from 100 to 1,000 tons. However, the Ministry of Agriculture and Rural Development (MINADER)—a government agency under the Japanese KRII program—which was suspended in 2001, imported a substantial quantity of the fertilizer that has been imported since 1995.

Table 7.2 shows the excessive cost of importing fertilizer in small quantities by container. Although some urea is imported, most imports are 12-24-12 NPK, and this is the example used here. Excessive port charges for unloading and clearing containers, high levels of taxes and duty, and high interest rates and container hire charges add almost $150/ton to the cost of fertilizer. Both wholesale margins and retail costs and margins are excessively high due in part to market uncertainty and high interest rates. As a result, the ratio of retail price to c.i.f. cost is 2.56, and the retail price in Angola in the Plano Alto region is almost four times higher than the f.o.b. price.

8. Holistic and Specific Solutions

The solutions proposed for improving fertilizer supply through market development are divided into two groups, namely, (a) the five pillars of market development and (b) supporting measures. These measures are followed by a discussion of options for fertilizer production and market-friendly safety nets.

Five Pillars of Market Development

In a holistic approach to fertilizer market development in SSA, five pillars are proposed as essential elements for sustainable market development to occur. These pillars are the policy environment; human capital development; access to finance; market information; and regulatory frameworks, as elaborated in the following paragraphs. These generic suggestions need to be adapted in the context of country-specific situations. The suggested improvements will help to shift the supply curve to the right, and thereby reduce transaction costs and improve accessibility to fertilizers in rural areas.

Policy Environment

A conducive and stable policy environment is essential for promoting the development of private sector-based input markets. This will require the removal of all price and non-price distortions introduced by the government, donors, NGOs, or other stakeholders. A distorted policy environment sends the wrong signals, discourages private-sector investments in market development, and keeps transaction costs high. Additionally, the national government needs to strive to ensure macroeconomic stability and develop infrastructures in rural areas.

Human Capital Development

During the past quarter of a century, input supply systems were a public sector monopoly in most African economies. Such monopolistic arrangements have deprived the private sector of the opportunity to learn about input marketing and risk-sharing arrangements. Therefore, the private sector is equally underdeveloped and needs help in mastering business, marketing, and technical skills to operate a successful inputs business. In this area, large-scale training and technical assistance efforts will be needed to build the necessary human capital.

In well-functioning fertilizer markets, farmers are served by an integrated chain of suppliers at all levels—import, wholesale, and retail. However, in many countries in Africa, distribution networks are underdeveloped or non-existent in rural areas. As a result, it is difficult for farmers to access good quality inputs. In many instances, farmers must travel 30–50 km to buy inputs. Such distances not only add to the cost but also create a psychological barrier against the use of inputs. Development of input dealers in rural areas is essential to improve the access to inputs.

Access to Business Finance

Finance is the life blood of business development, but limited access to finance resulting from high interest rates, underdeveloped financial infrastructures, stringent collateral requirements, and the risk-averse attitude of commercial banks toward agriculture and agribusiness make it difficult to obtain the necessary funds for business development. Equally difficult is to get a letter of credit (LC) for importing inputs. Innovative approaches are needed to alleviate the financial constraint to business development. Two risk-sharing funds are proposed to improve access to finance by importers and dealers.

The first fund is the Agricultural Input Import Fund (AIIF). This fund needs to be maintained in foreign exchange at the Central Bank of the country. Any importer interested in importing fertilizers or other inputs should have access to this fund to get an LC from the commercial bank. The fund should be managed in such a way that the importer provides 30% of the needed funds for an LC, and the commercial bank provides 70% as a loan. However, the Central Bank provides a guarantee for 30 percentage points of the 70% loan. This will help to reduce the cost of imported fertilizers by lowering the funds needed to acquire an LC.

The second fund is called the Agricultural Inputs Business Development Fund (AIBDF). This fund can be used to provide a financial guarantee for developing retail networks in rural areas. Any dealer who is trained and knowledgeable about the technical and commercial aspects of input business will be able to use a guarantee from this fund to invest in retail or wholesale business. Like the importer, the interested dealer provides 30% of the required capital; the commercial bank provides 70%; but 30% is guaranteed by the AIBDF. The AIBDF must be managed by a reputable commercial bank. By facilitating the availability of business capital, the AIBDF will help small and medium dealers in developing dealer networks in rural areas. In addition to these risk-sharing mechanisms, the local banks need training in using a "bonded warehouse" as collateral for an input business loan. Such an arrangement could reduce the working capital needed to start or expand an input business. This would allow a retailer to bring larger quantities of inputs from the town, store them in a bank-supervised warehouse, and draw down small lots of inputs as his or her sales increase. These two innovations could spur investment in business development, create more competition in the marketplace, and thereby reduce transaction costs.

Another source is the third-party finance. The main potential source of third-party finance is the fertilizer manufacturers who will often provide up to 50% credit for 30 days from shipment arrival. Such arrangements usually develop from established trading relationships and a history of prompt payment by way of LC. The small market size of many countries precludes most direct negotiation with overseas suppliers, and the reliance on importers who are general traders also reduces the possibilities for supplier finance. Regional procurement arrangements may offer opportunities for securing supplier credit on favorable terms. The promotion of business linkages between importers, wholesalers, and retailers could open the door for suppliers' credit for business development.

Market Information

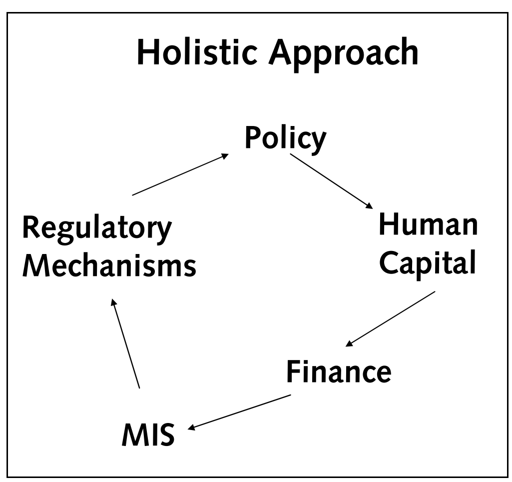
For a well-functioning market, the flow of information needs to be smooth and timely. Every player can have access to information about prices, stocks, and deliveries in various segments of the national, regional, and global markets. Yet, many dealers in Africa have little information about domestic markets. The transparency in market transactions is necessary. Such market transparency is promoted by establishing and operating a market information system (MIS) and by disseminating information to dealers, farmers, and policy makers about market conditions.

Regulatory Frameworks

The enactment and enforcement of regulations dealing with quality, quantity, nutrient contents, and truth-in-labeling are critical for a free-market system. Yet in many African countries, such regulatory systems are non-existent or ineffective, and poor quality and outdated products are not uncommon. There was little need for such regulation when the government was the supplier of inputs. Now that the government is no longer a supplier of inputs, it has to assume the responsibility of protecting consumers' interests. This responsibility is a public sector responsibility and could be discharged by the government by building the necessary capacity in the country.

Improvements in all these five areas can go a long way in reducing input prices in developing African economies, thereby making the need for subsidies unnecessary. However, it should be stressed that efforts in these areas should be planned and implemented in a *holistic* way (See figure 8.1) because fragmented and piecemeal efforts will not create the synergy needed to improve supply systems and reduce transaction costs. Within this framework, proper sequencing and phasing-in of the proposed measures will be needed at the country level.

Figure 8.1 Holistic Approach



Source: IFDC 2002.

Other Supporting Measures

Regional fertilizer trade cooperation and integration offer some opportunities to achieve economies of scale for the small fertilizer markets common in Sub-Saharan Africa. Together with improved market demand estimation through Market Information Systems, access to affordable trade, distribution and retail credit products, and improvements in transport efficiency there are opportunities to reduce farm gate fertilizer costs.

Economies of Scale in Procurement/Sourcing through Multi-Country Trade

As mentioned earlier, the size of the fertilizer market is small in many countries. As a result, the individual countries cannot realize the economies of scale in procurement and transportation and end up paying higher prices for imported fertilizers. To realize the economies of scale in procurement and shipping, importers in these countries can form a multi-country trading block and import inputs in bulk for the whole block. Two such examples include the MZM (Malawi-Zambia-Mozambique) Development Triangle and the Tanzania-Zambia-Malawi Block. The MZM Triangle is linked by the Beira port because most of the imports and exports in this triangle pass through that port. Rather than each country importing fertilizers in small quantities, these countries could realize economies of scale in procurement if the fertilizer requirements are pooled for all three countries. Likewise, Zambia and Tanzania are linked by the TAZARA railway line, and Tanzania and Malawi are joined by good highways. If the fertilizer requirements of southern Tanzania, northern Malawi, and northern Zambia are pooled and procured in bulk, the fertilizer price could be reduced by a significant margin. Such multi-country trading blocks will create a win-win situation for all.[11] It must be stressed that such pooling of import transactions needs to be private sector-based. Donors and the national governments could help to facilitate business linkages among the traders of various countries through training, technical assistance, policy workshops, and study tours.

Balancing Supply and Demand over an Annual Application Cycle

The often poorly developed demand estimates of the old government-controlled and vertically integrated supply systems at least provided some semblance of total demand estimation or supply allocation. In emerging competitive market systems, there is a need for coordination of supply response in a transparent manner through MIS. Alternative arrangements can be either a continuation of improved national MIS systems or private-sector trade association MIS systems.

Modes and Means of Mitigating Financial Risk for Each Link in the Chain

In many countries, access to finance for business development is difficult, if not impossible. Not only are interest rates high but also the collateral requirements are stringent. Many banks ask for 100–150% collateral. Because many input dealers have little tangible assets, except a house, they must rely on their own meager savings to develop input businesses. To alleviate this constraint, as mentioned earlier, warehouse collateral and bonded warehouses could be explored by the commercial banks. At the import and wholesale levels, supplier's credit can be encouraged through proper business linkages. Quick disposal of goods from the importer to the wholesaler and from the wholesaler to the retailer can also help to reduce risks in fertilizer import and marketing.

Improvements in Transportation Arrangements

Improvements in rural roads and railway capacity (covered wagon) have been stressed earlier. Additionally, by changing their procurement arrangements and routes, landlocked countries such as Zambia, Malawi, and Uganda could generate a saving in transportation costs. These improvements must be assessed and implemented at the country level but are illustrated for Zambia in Table 8.1. Currently, all Zambian importers are concentrated in Lusaka and mostly import from South Africa. Given the vast size of the country, such a concentration adds considerable cost to imported inputs. Promoting the development of importers in Chipata (connected to Nacala Port) and Kasama (connected to Dar-es-Salam Port) could significantly reduce the import cost of fertilizers in the eastern and northern provinces. These towns have willing and able entrepreneurs who could be trained to become fertilizer importers and wholesalers. This development alone could reduce the cost of imported fertilizers by $70/ton to $90/ton (ZK17, 500/bags to ZK22,500/bags) in the eastern and northern provinces.

Table 8.1 Freight Charges through Alternative Routes in Zambia

Route		US $/ton
I.	Johannesburg—Lusaka	90
	Lusaka—Kasama/Kapiri	50
Ia.	Total	140
Ib.	Dar-es-Salaam—Kapiri/Kasama	50
Ic.	Net saving in transportation costs via DSM route (Ia *minus* Ib)	90
II.	Johannesburg—Lusaka	90
	Lusaka—Chipata	40
IIa.	Total	130
IIb.	Nacala to Chipata	60
IIc.	Net saving in transportation costs via Nacala route (IIa *minus* IIb)	70

Source: IFDC and FSRP/MSU 2004.

Note: For realizing a saving on the Nacala-Chipata route, it is assumed that a 21-km segment of railway track between Mchinji (at the Malawi border) and Chipata will be completed soon.

As mentioned earlier, if importers in Kasama, Zambia, link up with importers in Mbeya, Tanzania, an additional saving could be realized through economies of scale in procurement. A careful analysis of country-specific situations could open similar opportunities for other countries.

Options for Fertilizer Production

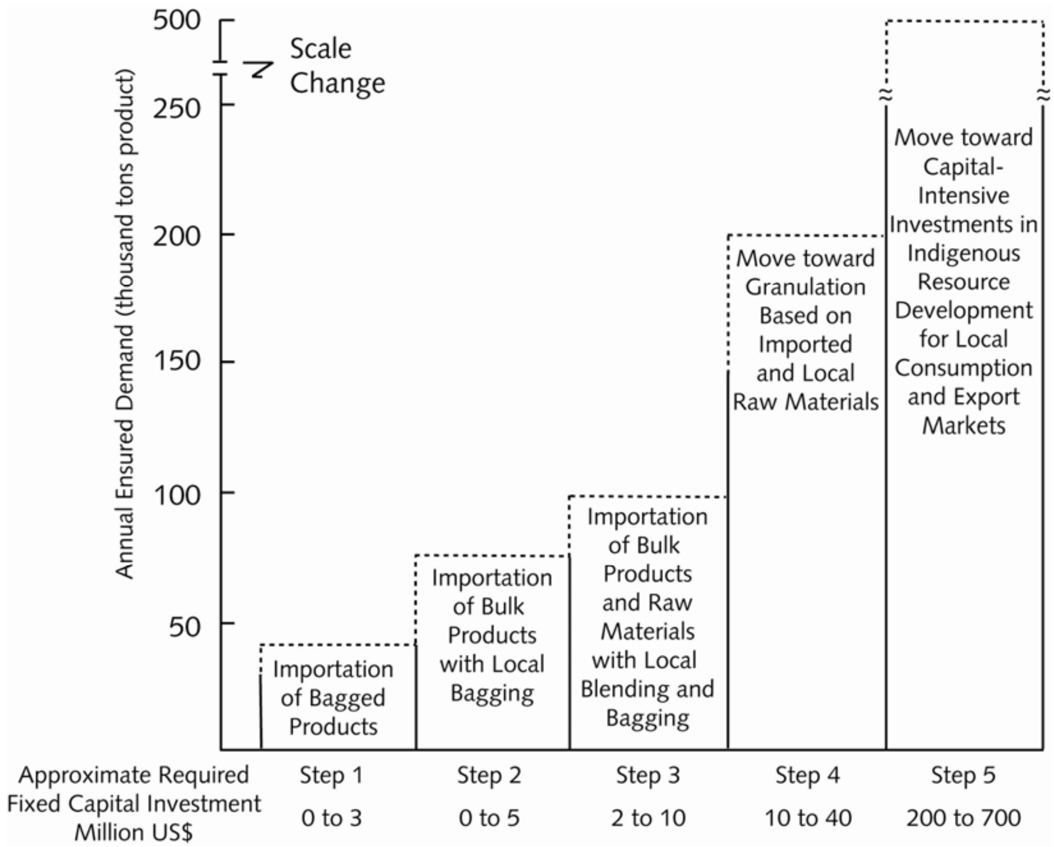
It has been mentioned several times in this paper that fertilizer production is capital intensive and involves substantial economies of scale. A typical ammonia/urea complex produces more than 550,000 tons of urea. Similarly, DAP, TSP, or NPK plants offer economies of scale. Because every country needs all macronutrients (N, P_2O_5, and K_2O) and some micronutrients, it cannot economically justify investing in several plants. Because there is no shortage of fertilizer products in the global market, individual countries can continue to depend on imports and make improvements in procurement and marketing systems to minimize costs, until the size of the market is large enough to justify production investment.

Nevertheless, individual countries can consider other production options suitable for their market. Figure 8.2 lists five steps in progression toward large-scale production in the country. If the national demand is less than 50,000 product tons (20,000 nutrient tons), the country can import bagged products or bulk with bagging at the port. This option requires a small capital investment.[12] If the market size is more than 50,000 product tons but less than 100,000 product tons, the country can consider importing in bulk with local bagging facilities, or it can import different products and raw materials and produce blended products. A few countries such as Malawi, Zambia, Nigeria, Zimbabwe, and Côte d'Ivoire have invested in blending and bagging facilities. Countries are cautioned to produce only a few selected blended products needed for different crops or agroecological conditions. If the market size is 200,000 product tons or more, the country can opt for granulation facilities. The differences between blending and granulation are as follows.

Under blending operations, various products such as urea, DAP, and MOP are blended to create a mixture of NPK products; these mixtures contain various granules of urea, DAP, MOP, and any other products like sulfur are included in the mixture. With granulation, various products are dissolved into a homogeneous slurry and then granulated so that each granule contains all nutrients such as N, P_2O_5, and K_2O. For example, each granule of NPK 15-15-15 granulated product contains 15% N, 15% P_2O_5, and 15% K_2O. Obviously, granulation units are relatively more costly, but granulated NPK products yield better agronomic efficiency and could be transported anywhere in the country. In contrast, blended products are suitable for distribution to nearby markets. If blended products are transported over long distances and country roads are bumpy (not uncommon in Africa), NPK mixtures can segregate; heavier granules of DAP, for example, will settle at the bottom and the lighter ones (i.e., prilled urea) at the top. The disadvantage of such a product is that when the farmer is broadcasting (spreading by hand) the product, some parts of the field will receive only urea, another will receive DAP, and still another part may receive filler (lime or sand). Many farmers in Malawi have noted this problem with various compound mixtures. Consequently, the farmer is not obtaining the full benefit of NPK products. When the market size reaches 300,000–500,000 product tons of a single product, the country can consider investing in a large-scale production unit.

Although it may be difficult to justify investing in large-scale production facilities in individual countries, investment in a production facility could be made for a regional market with potential for exports. For example, if Southern African Development Community (SADC) countries can harmonize their policies and practices, some private investor could invest in an ammonia/urea unit in

Figure 8.2 Example of Stepwise Development of Fertilizer Production/ Supply Units



Source: Schultz and Parish (1989).

Mozambique (using local natural gas), and supply the whole SADC market and export surplus product to Asian countries. Likewise, in the Economic Community of West African States (ECOWAS) and the East African Community (ECA), it's possible to think of investment for regional markets. However, because these units will be Greenfield projects (i.e., projects in a new location with little infrastructure), their economic viability will need to be assessed carefully because their product must compete with imported products produced from the existing units. Because many fertilizer plants in the past became "white elephants" (Madagascar, Somalia, Cameroon, and Zambia), great caution is warranted about making investments in large-scale production facilities. Except for Nigeria where prospects for rehabilitating old NAFCON are good, no other SSA country can justify investment in a large-scale fertilizer plant for its domestic market. Detailed feasibility studies are needed for investment in fertilizer production for regional markets.

Product Rationalization: Unnecessary product differentiation such as cotton formula in Western Africa or various compounds in Malawi adds to the cost of production and creates confusion among the farmers. Countries can reduce costs by rationalizing their product slate and by encouraging the use of internationally traded products. Even if NPKs are required, the number of such products can be kept to a minimum. Most Asian markets relied and continue to rely heavily on straight fertilizer products traded in the global market. SSA countries can also benefit by switching from low-analysis products (SSP, AS) to high-analysis products (urea, TSP, DAP, MOP, and NPK 15-15-15) so that transportation cost per ton of nutrient is lower. The rationalization of the product slate must go hand-in-hand with fertilizer recommendations and agronomic improvements.

Harmonization of cotton fertilizer formula in West Africa can yield a substantial saving (See table 8.2). Data in the table were prepared in 2000 and reflect a saving on the prices prevailing in that year in both global and national markets. Also, these data should be taken as suggestive because an actual saving resulting from proposed improvements requires a detailed feasibility study of establishing a blending or granulation plant for producing a common cotton fertilizer for West African countries (See IFDC 2001). Moving away from country-specific tailor-made products could yield a saving of \$30–\$40 per ton in procurement costs alone. When this saving is combined with that resulting from economies of scale in production and transportation, \$60–\$70/ton could be saved. Local bagging and blending and improvements in marketing could lead to a further saving of \$53–\$67/ton. Thus, this example suggests a minimum saving of more than \$100/ton, resulting from both developing a multi-country market and rationalizing fertilizer products. A technical feasibility study is needed to estimate this saving more accurately.

Table 8.2 Potential Saving from Harmonization of Cotton Formula in West Africa: Preliminary Estimates

Activity/Element	Potential Saving
	(US \$/ton)
Non-specialty product effect	30–40
Scale effect	
Production	20–25
Transportation	10–12
Local bagging (bulk imports)	8–12
Local blending[a] (bulk import of raw materials)	30–35
Improvements in marketing	15–20

[a] Local blending of cotton formula should use boron-based material or use boron through foliar application.

Source: IFDC 2001.

Poverty Alleviation and Market-Friendly Safety Nets

Many government interventions in input supply are guided by the need to help resource-poor farmers who suffer from transitory or chronic food insecurity. Likewise, donor and NGO programs for free distribution of inputs (i.e., seed and/or fertilizers) are also guided by greater humanitarian goals of poverty alleviation or helping poor people during an emergency caused by natural or manmade disasters. As long as one out of every three Africans suffer from hunger and malnutrition and over one-half of the population suffers from poverty (earning less than $1/day), it will be difficult to make a case that programs focused on reducing hunger and malnutrition cannot be implemented because they have a "distortionary" impact (e.g., resulting from free or subsidized input distribution) on input markets. On the other hand, if poverty alleviation programs are not implemented in a market-friendly manner, there is a modest chance that SSA will have sustainable input supply systems in the short-to-medium term. Thus, there is a need to develop a mechanism that can support both poverty alleviation and market development.

The twin objectives of poverty alleviation and market development can be achieved if the support programs are implemented by transferring the purchasing power to the needy farmers, as done in the United States through food stamps. Rather than giving free or subsidized seed or fertilizers, the targeted farmer should be given a voucher that the farmer can exchange for inputs from a dealer in the village. The voucher can have either the full or the partial value of inputs. The dealer who sells inputs for vouchers should be guaranteed to receive full payment from an authorized bank, which gets its funds from the implementing agency (government, donor, or NGO). IFDC has implemented such programs successfully in Afghanistan and Malawi. In Tanzania some agencies such as the Coffee and Cashew Boards have used vouchers for inputs, but because monitoring mechanisms were not well-designed and executed for coffee vouchers, the program suffered from fraud and misuse. Better monitoring mechanisms are needed to minimize misuse and fraud. Therefore, national governments, donors, and NGOs can "marketize" their input support programs through the use of vouchers.

The voucher system "kills two birds with one stone." It empowers the food-insecure farmers to produce more food for their families and facilitates their "inclusion" in the marketplace, and strengthens the market development process by injecting additional purchasing power into the system. There are different variations of the voucher system that could be adapted to local conditions depending on whether the farmer deserves full or partial support or seasonal credit to buy inputs and repay it in kind or cash at harvesting or contribute labor to public work programs in exchange of vouchers.

Appendix A. Fertilizer Consumption, Production, and Trade by Countries

Table A-1 Sub-Saharan Africa: Fertilizer Consumption and Imports by Country, 2002/2003

	Consumption				Imports			
	Total	N	P_2O_5	K_2O	Total	N	P_2O_5	K_2O
Country	(mt nutrients)				(mt nutrients)			
Benin	47,841	25,541	12,300	10,000	47,841	25,541	12,300	10,000
Botswana	4,600	4,100	300	200	4,600	4,100	300	200
Burkina Faso	1,671	926	463	282	1,671	926	463	282
Burundi	2,539	852	711	976	2,539	852	711	976
Cameroon	34,899	13,149	8,638	13,112	34,899	13,149	8,638	13,112
Cape Verde	220	220	-	-	248	248	-	-
Central African Republic	600	200	200	200	600	200	200	200
Chad	17,500	11,000	2,000	4,500	17,500	11,000	2,000	4,500
Comoros	300	100	100	100	300	100	100	100
Congo, Dem Republic of	10,513	3,785	4,599	2,129	10,513	3,785	4,599	2,129
Congo, Republic of	236	195	21	20	236	195	21	20
Côte d'Ivoire	109,000	53,000	30,000	26,000	166,762	62,491	51,633	52,638
Eritrea	3,676	2,625	1,051	-	3,505	2,835	670	-
Ethiopia	150,032	77,373	72,659	-	190,800	95,000	95,800	-
Gabon	300	100	100	100	300	100	100	100

Table A-1 Sub-Saharan Africa: Fertilizer Consumption and Imports by Country, 2002/2003

Country	Consumption				Imports			
	Total	N	P_2O_5	K_2O	Total	N	P_2O_5	K_2O
	(mt nutrients)				(mt nutrients)			
Gambia	800	600	100	100	800	600	100	100
Ghana	31,030	14,170	8,590	8,270	31,030	14,170	8,590	8,270
Guinea	3,200	1,000	1,400	800	3,200	1,000	1,400	800
Guinea-Bissau	2,400	1,000	700	700	2,400	1,000	700	700
Kenya	142,758	56,961	82,548	3,249	134,945	62,360	67,081	5,504
Lesotho	11,300	4,900	3,400	3,000	11,300	4,900	3,400	3,000
Madagascar	9,125	2,182	3,975	2,968	9,125	2,182	3,975	2,968
Malawi	193,008	130,253	28,979	33,776	193,008	130,253	28,979	33,776
Mali	42,000	14,000	14,000	14,000	42,000	14,000	14,000	14,000
Mauritania	2,900	2,900	-	-	2,900	2,900	-	-
Mauritius	25,000	6,900	8,000	10,100	32,335	2,500	14,085	15,750
Mozambique	24,900	16,000	2,000	6,900	26,600	17,700	2,000	6,900
Namibia	300	100	200	-	300	100	200	-
Niger	4,970	3,360	970	640	5,070	3,380	1,010	680
Nigeria	166,200	94,400	41,400	30,400	166,200	94,400	41,400	30,400
Rwanda	15,299	5,164	5,087	5,048	15,299	5,164	5,087	5,048
Réunion	5,000	2,300	1,500	1,200	5,000	2,300	1,500	1,200
Senegal	33,491	21,382	6,000	6,109	37,491	12,382	-	25,109
Seychelles	17	5	5	7	-	-	-	-

Table A-1 Sub-Saharan Africa: Fertilizer Consumption and Imports by Country, 2002/2003

	Consumption				Imports			
	Total	N	P_2O_5	K_2O	Total	N	P_2O_5	K_2O
Country	(mt nutrients)				(mt nutrients)			
Sierra Leone	300	100	100	100	300	100	100	100
Somalia	500	500	-	-	500	500	-	-
Sudan	69,496	54,596	11,100	3,800	69,496	54,596	11,100	3,800
Swaziland	7,000	2,000	2,500	2,500	7,000	2,000	2,500	2,500
Tanzania, United Rep of	7,148	6,206	442	500	9,372	7,371	1,415	586
Togo	17,055	7,172	4,927	4,956	17,055	7,172	4,927	4,956
Uganda	9,306	4,330	2,698	2,278	9,306	4,330	2,698	2,278
Zambia	65,168	33,296	15,523	16,349	66,370	34,498	15,523	16,349
Zimbabwe	110,000	60,000	30,000	20,000	27,750	6,935	1,435	19,380
Sub-Saharan Africa	1,383,598	738,943	409,286	235,369	1,408,466	709,315	410,740	288,411

Source: FAO data.

Table A-2 Sub-Saharan Africa Total Fertilizer Consumption by Country, 1990/91 – 2002/03

Country	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03
	(mt N + P_2O_5 + K_2O)												
Angola	9,500	6,900	9,100	8,000	10,000	8,000	6,000	2,000	3,400	3,400	1,400	-	-
Benin	11,003	11,817	15,325	17,238	17,055	36,000	30,681	38,968	37,707	56,700	35,200	31,100	47,841
Botswana	900	900	900	1,000	1,000	2,284	3,341	3,800	4,248	4,600	4,600	4,600	4,600
Burkina Faso	21,166	20,686	21,336	21,000	22,651	24,308	24,095	42,577	50,232	43,400	33,923	1,671	1,671
Burundi	2,100	2,100	5,201	3,844	3,100	3,000	2,800	1,000	3,615	3,970	3,500	3,500	2,539
Cameroon	21,800	18,100	20,900	22,304	30,000	30,000	34,000	39,190	39,533	49,510	46,084	52,502	34,899
Cape Verde	-	-	-	-	-	-	-	102	114	187	129	243	220
Central African Republic	940	900	1,100	1,200	300	300	300	300	600	600	600	600	600
Chad	5,800	8,600	10,076	5,252	7,000	8,558	11,900	7,850	16,820	17,500	17,500	17,500	17,500
Comoros	-	100	100	100	300	300	300	300	300	300	300	300	300
Congo, Dem Republic of	6,200	8,200	2,300	4,100	10,404	9,000	6,000	-	2,954	742	800	1,965	10,513
Congo, Republic of	1,575	1,400	2,000	2,000	1,900	2,000	4,000	4,000	5,000	5,000	5,000	4,625	236
Côte d'Ivoire	37,000	38,700	37,000	54,000	65,000	66,000	70,500	110,000	90,000	70,600	67,100	68,700	109,000
Eritrea	-	-	-	700	1,300	1,614	4,993	6,000	6,500	10,900	10,900	5,468	3,676
Ethiopia	-	-	-	75,900	116,100	134,300	177,549	131,732	164,062	167,877	157,480	134,913	150,032
Ethiopia PDR	77,100	66,100	88,100	-	-	-	-	-	-	-	-	-	-
Gabon	1,121	600	500	400	400	400	200	200	433	300	300	300	300
Gambia	600	900	800	800	800	944	805	1,100	2,500	1,200	800	800	800

Table A-2 Sub-Saharan Africa Total Fertilizer Consumption by Country, 1990/91 – 2002/03

Country	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03
	(mt N + P_2O_5 + K_2O)												
Ghana	13,000	8,000	10,100	7,568	7,700	9,700	17,400	21,316	15,184	15,406	11,886	31,027	31,030
Guinea	1,161	1,938	506	1,575	4,000	5,106	4,249	1,796	3,284	3,200	3,200	3,200	3,200
Guinea-Bissau	586	544	236	300	300	300	300	300	600	600	2,400	2,400	2,400
Kenya	106,700	112,700	101,900	100,000	129,800	78,400	160,800	134,400	127,100	148,100	145,705	149,990	142,758
Lesotho	4,600	5,900	5,700	6,000	5,300	5,904	6,082	5,606	6,000	5,039	7,994	11,341	11,300
Liberia	300	-	-	-	-	-	-	-	-	-	-	-	-
Madagascar	10,855	9,472	7,697	11,083	11,266	12,546	16,669	9,500	8,677	7,874	9,111	9,051	9,125
Malawi	48,000	70,000	73,800	74,000	21,283	43,519	58,200	56,800	50,200	50,100	49,791	27,482	193,008
Mali	15,200	15,000	27,300	25,000	25,000	27,000	27,300	47,800	45,900	49,800	39,847	42,000	42,000
Mauritania	3,900	5,150	7,283	4,608	4,000	4,000	5,000	1,722	1,800	2,400	-	2,900	2,900
Mauritius	27,733	27,575	26,638	26,005	29,208	31,891	37,727	33,456	33,101	35,300	37,500	28,550	25,000
Mozambique	2,600	5,100	4,900	3,200	6,300	7,800	8,100	6,500	8,000	8,000	14,300	24,900	24,900
Namibia	-	-	-	-	-	-	-	-	100	300	300	300	300
Niger	2,299	530	1,400	1,500	6,115	9,979	9,000	700	500	4,188	4,524	4,982	4,970
Nigeria	400,380	429,200	440,000	461,000	296,000	183,000	173,500	137,700	163,200	167,700	187,500	221,000	166,200
Rwanda	2,989	1,583	690	1,400	-	-	300	400	300	300	300	300	15,299
Réunion	12,100	14,000	15,077	15,400	7,400	6,400	9,100	7,000	5,600	5,600	4,800	5,000	5,000
Senegal	11,750	16,630	17,000	24,000	25,900	16,200	21,600	22,900	25,600	37,800	38,200	29,900	33,491
Seychelles	-	-	-	-	-	-	-	-	-	23	42	20	17
Sierra Leone	1,300	600	1,400	3,000	3,000	3,000	3,000	3,000	300	90	150	300	300

Table A-2 Sub-Saharan Africa Total Fertilizer Consumption by Country, 1990/91 – 2002/03

Country	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03
	(mt N + P_2O_5 + K_2O)												
Somalia	2,700	-	-	-	-	-	500	500	500	500	500	500	500
Sudan	81,900	55,700	59,500	52,900	58,400	51,700	95,400	77,400	37,700	38,800	40,700	84,200	69,496
Swaziland	13,397	11,500	12,400	11,600	4,900	5,095	4,224	5,200	5,800	5,500	5,800	7,000	7,000
Tanzania, United Rep of	46,800	49,679	47,923	36,300	35,900	27,000	31,214	39,980	30,856	20,980	22,404	7,874	7,148
Togo	11,500	11,744	12,230	9,865	11,164	16,433	17,612	16,810	17,200	16,900	19,838	19,200	17,055
Uganda	192	1,200	800	2,200	1,900	1,300	600	600	3,535	4,479	6,639	5,800	9,306
Zambia	59,500	62,491	84,500	85,400	59,000	55,000	51,400	56,700	36,700	34,012	31,391	36,400	65,168
Zimbabwe	167,685	164,322	113,600	159,416	170,700	145,000	168,000	175,000	175,000	185,000	165,300	152,200	110,000
Sub-Saharan Africa	1,245,932	1,266,561	1,287,318	1,341,158	1,211,846	1,073,281	1,304,741	1,252,205	1,230,755	1,284,777	1,235,738	1,236,604	1,383,598

Source: FAO data.

Table A-3 Sub-Saharan Africa Total Fertilizer Imports by Country, 1990/91 – 2002/03

Country	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03
	(mt N + P_2O_5 + K_2O)												
Angola	6,500	6,900	9,100	8,000	10,000	8,000	6,000	2,000	4,500	2,300	1,400	-	-
Benin	10,734	12,171	16,367	17,641	17,002	36,000	29,635	38,968	37,707	56,700	35,200	31,100	47,841
Botswana	900	900	900	1,000	1,000	2,501	3,543	3,800	4,248	4,600	4,600	4,600	4,600
Burkina Faso	18,701	21,484	21,034	20,700	23,173	24,217	31,227	43,990	49,932	42,500	33,540	1,671	1,671

Table A-3 Sub-Saharan Africa Total Fertilizer Imports by Country, 1990/91 – 2002/03

Country	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03
	(mt N + P_2O_5 + K_2O)												
Burundi	2,100	2,100	6,362	5,025	3,100	3,000	2,500	1,000	3,615	3,970	3,500	3,500	2,539
Cameroon	22,700	18,100	20,900	22,304	47,400	31,700	34,000	39,190	39,533	49,510	46,084	52,502	34,899
Cape Verde	-	-	-	-	-	-	-	183	132	198	145	271	248
Central African Republic	940	900	1,100	1,200	300	300	300	300	600	600	600	600	600
Chad	5,800	8,600	10,076	5,252	8,000	8,000	23,900	7,850	16,820	17,500	17,500	17,500	17,500
Comoros	-	100	100	100	300	300	300	300	300	300	300	300	300
Congo, Dem Republic of	6,200	8,200	2,300	4,100	10,404	9,000	6,000	-	2,954	742	800	1,965	10,513
Congo, Republic of	1,575	1,400	2,000	2,000	2,900	3,000	4,000	4,000	5,000	5,000	5,000	4,625	236
Côte d'Ivoire	35,600	40,800	67,800	52,200	79,000	86,800	75,000	181,400	135,300	106,500	103,200	89,500	166,762
Eritrea	-	-	-	1,000	1,600	1,900	5,650	6,000	6,500	10,900	10,900	3,705	3,505
Ethiopia	-	-	-	115,100	35,400	148,700	250,900	92,500	166,300	167,877	157,480	206,915	190,800
Ethiopia PDR	113,600	61,400	130,600	-	-	-	-	-	-	-	-	-	-
Gabon	1,121	600	500	400	400	400	200	200	433	300	300	300	300
Gambia	600	900	800	800	800	944	805	1,100	2,500	1,200	800	800	800
Ghana	7,400	8,000	10,500	7,336	7,700	9,700	17,400	22,463	15,184	15,406	11,886	31,027	31,030
Guinea	1,161	1,938	506	1,575	4,000	5,106	4,249	1,796	3,284	3,200	3,200	3,200	3,200
Guinea-Bissau	586	544	236	300	300	300	300	300	600	600	2,400	2,400	2,400
Kenya	106,700	112,700	101,900	100,000	131,000	78,400	160,800	134,400	127,100	149,100	152,877	161,627	134,945

Table A-3 Sub-Saharan Africa Total Fertilizer Imports by Country, 1990/91 – 2002/03

Country	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03
	(mt N + P_2O_5 + K_2O)												
Lesotho	4,600	5,900	5,700	6,000	5,500	6,112	6,579	5,606	6,000	5,830	7,994	11,341	11,300
Liberia	300	-	-	-	-	-	-	-	-	-	-	-	-
Madagascar	10,855	9,472	7,697	11,083	11,266	12,546	16,669	9,500	8,677	7,874	9,111	9,051	9,125
Malawi	48,000	75,600	68,200	74,000	21,283	43,519	58,200	56,800	50,200	50,100	49,791	27,482	193,008
Mali	19,000	12,500	27,300	25,000	25,000	27,000	27,300	47,800	45,900	49,800	43,507	42,000	42,000
Mauritania	4,900	6,650	9,292	7,370	4,000	4,000	5,000	1,722	1,800	2,400	-	2,900	2,900
Mauritius	28,958	25,069	28,364	21,660	23,500	24,210	37,690	36,334	24,300	22,900	27,000	30,920	32,335
Mozambique	2,600	5,100	4,900	3,200	6,300	8,800	8,100	6,500	8,000	8,000	15,500	26,600	26,600
Namibia	-	-	-	-	-	-	-	-	100	300	300	300	300
Niger	2,299	530	1,400	1,500	4,730	8,032	8,500	700	500	4,362	5,062	5,067	5,070
Nigeria	287,600	207,100	240,000	281,000	290,300	23,700	77,200	91,500	127,700	97,700	187,500	221,000	166,200
Rwanda	840	1,583	690	1,400	-	-	300	400	300	300	300	300	15,299
Réunion	12,100	14,000	15,077	15,400	7,400	6,400	9,100	7,000	5,600	5,600	4,800	5,000	5,000
Senegal	29,300	30,890	27,000	34,900	13,900	18,200	15,500	34,200	26,400	36,300	30,600	34,900	37,491
Seychelles	-	-	-	-	-	-	-	-	-	44	45	31	-
Sierra Leone	1,300	600	1,800	3,000	3,000	3,000	3,000	3,000	300	90	150	300	300
Somalia	2,700	-	-	-	-	-	500	500	500	500	500	500	500
Sudan	81,900	55,700	59,500	52,900	60,400	49,700	95,400	77,400	37,700	57,000	52,414	84,200	69,496
Swaziland	13,397	11,500	12,400	11,600	4,700	5,154	4,224	5,200	5,800	5,500	5,800	7,000	7,000

Table A-3 Sub-Saharan Africa Total Fertilizer Imports by Country, 1990/91 – 2002/03

Country	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03
	(mt N + P_2O_5 + K_2O)												
Tanzania, United Rep of	44,770	53,228	40,154	41,700	30,500	27,000	35,339	39,063	30,856	20,980	22,404	11,791	9,372
Togo	11,500	7,415	12,403	12,672	12,626	14,445	21,841	16,810	17,200	16,900	19,838	19,200	17,055
Uganda	192	1,200	800	2,200	1,900	1,300	600	600	3,535	4,479	7,029	6,500	9,306
Zambia	62,000	62,600	85,700	68,300	53,000	51,800	47,400	52,800	34,400	31,065	31,204	40,000	66,370
Zimbabwe	46,420	38,700	44,300	48,900	63,300	33,500	81,200	87,300	70,400	77,200	70,500	69,600	27,750
Sub-Saharan Africa	1,058,449	933,074	1,095,758	1,089,818	1,026,384	826,686	1,216,351	1,162,475	1,128,710	1,144,227	1,183,061	1,274,091	1,408,466

Source: FAO data.

Table A-4 Sub-Saharan Africa Total Fertilizer Production by Country, 1990/91 - 2002/03

Country	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03
	(mt N + P_2O_5 + K_2O)												
Burkina Faso	116	162	256	300	300	300	300	300	300	900	383	-	-
Côte d'Ivoire	1,500	2,500	2,700	2,500	-	-	-	-	-	-	-	-	-
Mauritius	11,975	12,409	14,611	12,632	15,398	15,600	16,190	14,321	14,400	12,400	16,800	14,550	15,300
Nigeria	327,600	318,600	371,200	330,000	157,700	138,900	123,800	46,200	81,500	70,000	-	-	-
Senegal	64,940	73,207	58,000	62,000	61,100	68,200	60,200	85,400	106,300	69,500	51,800	57,900	62,700
Tanzania, United Rep of	4,905	5,718	-	-	-	-	-	-	-	-	-	-	-
Zambia	10,600	4,720	13,700	10,800	6,000	4,000	4,100	4,000	2,300	1,702	900	-	-
Zimbabwe	125,600	126,000	112,500	120,300	136,000	120,700	122,000	121,400	109,600	124,000	101,400	85,600	99,350
Sub-Saharan Africa	547,236	543,316	572,967	538,532	376,498	347,700	326,590	271,621	314,400	278,502	171,283	158,050	177,350

Source: FAO data.

Table A-5 Sub-Saharan Africa Total Fertilizer Exports by Country, 1990/91 - 2002/03

Country	1990/91	1991/92	1992/93	1993/94	1994/95	1995/96	1996/97	1997/98	1998/99	1999/00	2000/01	2001/02	2002/03
	(mt N + P_2O_5 + K_2O)												
Côte d'Ivoire	-	-	-	-	-	-	-	27,000	48,000	30,000	30,000	12,000	33,900
Mauritius	5,914	6,011	9,945	5,733	5,600	3,400	8,571	5,412	7,500	2,200	-	12,776	18,812
Mozambique	-	-	-	-	-	-	-	-	-	-	-	-	-
Nigeria	122,100	113,200	94,600	92,000	79,300	44,400	26,700	-	-	-	-	-	-
Senegal	32,350	25,248	40,400	35,000	22,900	29,400	28,300	43,000	45,100	35,000	21,600	56,100	41,000
Zambia	-	-	-	-	-	200	100	100	-	-	-	-	361
Zimbabwe	3,438	4,000	7,100	4,700	-	700	2,100	12,000	7,200	1,900	-	-	2,190
Sub-Saharan Africa	163,802	148,459	152,045	137,433	107,800	78,100	65,771	87,512	107,800	69,100	51,600	80,876	96,263

Source: FAO data.

Appendix B. Regional Classification

IFDC Regional Classification

North America	Western Europe	Eastern Europe	Eurasia	Oceania	Africa	Latin America	Asia
Canada	Austria	Albania	Armenia	Australia	*Sub-Saharan Africa*	*Central America*	*West Asia*
United States[a]	Belgium-Lux	Bosnia-Herzegovina	Azerbaijan	Fiji	Angola	Bahamas	Bahrain
	Denmark	Bulgaria	Belarus	French Polynesia	Benin	Barbados	Cyprus
	Finland	Croatia	Estonia	New Caledonia	Botswana	Belize	Iran
	France	Czech Republic	Georgia	New Zealand	Burkina Faso	Bermuda	Iraq
	Germany	Hungary	Kazakhstan	Pacific Islands	Burundi	Costa Rica	Israel
	Greece	Macedonia	Kyrgyzstan	Papua New Guinea	Cameroon	Cuba	Jordan
	Iceland	Poland	Latvia	Samoa	Cape Verde	Dominica	Kuwait
	Ireland	Romania	Lithuania	Tonga	Central African Republic	Dominican Republic	Lebanon
	Italy	Serbia and Montenegro	Moldova		Chad	El Salvador	Oman
	Malta	Slovakia	Russia		Comoros	Grenada	Qatar
	Netherlands	Slovenia	Tajikistan		Congo	Guadeloupe	Saudi Arabia
	Norway		Turkmenistan		Congo, DR	Guatemala	Syria
	Portugal		Ukraine		Cote d'Ivoire	Haiti	Turkey
	San Marino		Uzbekistan		Djibouti	Honduras	United Arab Emirates
	Spain				Equatorial Guinea	Jamaica	Yemen[f]

IFDC Regional Classification

North America	Western Europe	Eastern Europe	Eurasia	Oceania	Africa	Latin America	Asia
	Sweden				Eritrea	Martinique	*South Asia*
	Switzerland				Ethiopia	Mexico	Afghanistan
	United Kingdom				Gabon	Netherland Antilles	Bangladesh
					Gambia	Nicaragua	Bhutan
					Ghana	Panama	India
					Guinea	St. Kitts	Myanmar
					Guinea Bissau	Saint Lucia	Nepal
	Developed Markets: North America, Western Europe, and Oceania				Kenya	St. Vincent	Pakistan
					Lesotho	Trinidad, etc.	Sri Lanka
	Transitional Markets: Eastern Europe and Eurasia				Liberia	Virgin Islands	*East Asia*
					Madagascar	*South America*	Brunei
	Developing Markets: Africa, Latin America, and Asia				Malawi	Argentina	Cambodia
					Mali	Bolivia	China
	Developed Countries: North America, Western Europe, Eastern Europe, Eurasia, Japan, Israel, South Africa, Australia, and New Zealand				Mauritania	Brazil	Indonesia
					Mauritius	Chile	Japan
	Developing Countries: Latin America, Asia (except Japan and Israel), Africa (except South Africa), and Oceania (except Australia and New Zealand)				Mozambique	Colombia	Korea, DPR
					Namibia	Ecuador	Korea, Republic
					Niger	French Guiana	Laos
					Nigeria	Guyana	Malaysia
					Reunion	Paraguay	Mongolia
					Rwanda	Peru	Nauru
					Senegal	Suriname	Philippines
					Seychelles	Uruguay	Singapore
					Sierra Leone	Venezuela	Taiwan
					Somalia		Thailand
					Sudan		Viet Nam
					Swaziland		
					Tanzania		

IFDC Regional Classification

North America	Western Europe	Eastern Europe	Eurasia	Oceania	Africa	Latin America	Asia
					Togo		
					Uganda		
					Zambia		
					Zimbabwe		
					South Africa		
					Republic of South Africa		
					North Africa		
					Algeria		
					Egypt		
					Libya		
					Morocco		
					Tunisia		

a. Includes Puerto Rico.

Source: IFDC

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Endnotes

1. Tons = metric tons.

2. Country-specific data on fertilizer consumption, production, and trade are included in Annex A.

3. On an existing site, an ammonia/urea unit could be built in 2 years at a cost of $300–$350 million.

4. In 2004, Angola imported less than 8,000 tons of urea.

5. This section is extracted from the information available in IFDC, IITA, and WARDA (2001); IFDC, DAI, and MTL (2002); IFDC (2002); IFDC, SG2000, and IDEA Project (2003); IFDC (2004); and IFDC and FSRP/MSU (2004).

6. A draft fertilizer law is being prepared.

7. See IFDC (2003) for details on distortions and inefficiencies resulting from subsidized fertilizer distribution systems.

8. In July 2005 the Government of Malawi authorized old parastatals, Smallholder Farmers' Fertilizer Revolving Fund of Malawi (SFFRF), and Agricultural Marketing Corporation of Malawi (ADMARC), to import and distribute fertilizers at a subsidized price (personal communication).

9. Because of this paper's focus on the supply side of the market equation, issues related to demand and farm-level credit, are not covered here.

10. In reality, these countries could be paying higher procurement prices by sourcing the product from non-optimal sources or in smaller lots.

11. See page 48 for a saving resulting from the harmonization of cotton formula in West Africa.

12. Capital requirement estimates included here should be considered suggestive and should be appraised in a country-specific context.