Africa Fertilizer Summit
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Background Papers

Overview of the Fertilizer Situation in Africa

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Background Paper Prepared for the African Fertilizer Summit

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by

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Acronyms and Abbreviations

AU	African Union
CAADP	Comprehensive Africa Agriculture Development Programme
c.i.f.	Cost, insurance, and freight
ECA	Economic Commission for Africa
FAO	Food and Agriculture Organization of the United Nations
GOK	Government of Kenya
MDG	Millennium Development Goal
NEPAD	New Partnership for Africa's Development
NGO	Non-Governmental Organization
IFAD	International Fund for Agricultural Development
IFDC	International Fertilizer Development Center (an International Center for Soil Fertility and Agricultural Development)
SSA	Sub-Saharan Africa
tpy	Tons per year
WB	World Bank

Executive Summary

With more than 70% of African people living in rural areas and 75% of them living on less than a $1 per day, it is clear that sustainable increases in agricultural productivity and rural incomes are the basis for broad-based economic growth. That is why a call for action has been sent by Kofi Annan, Secretary General of the United Nations: the time has come for a uniquely African Green Revolution. The central challenge remains how best to create conditions under which farmers can intensify their production systems and increasingly link them to markets.

Governments, donor agencies, and non-governmental organizations (NGOs) have tried many different strategies, including direct subsidies on fertilizer prices, distribution of vouchers that can be redeemed for fertilizer, distribution of starter packs for farmers to experiment with fertilizer, and fertilizer-for-work programs. While many of these approaches have achieved some short-term successes, many collapsed once external funding ended, making them unsustainable over the longer term. The failures of many past interventions to have long-lasting effects on the fertilizer sector can be explained by the many constraints that affect fertilizer supply and use in both commercial and food crop sectors.

To help understand the fertilizer situation in Africa, this paper (1) describes trends in fertilizer demand and supply, focusing on cross-country differences in fertilizer intensity use and supply levels; (2) examines the evolution of past policies and interventions, their impacts on the fertilizer sector, and the constraints affecting fertilizer demand and supply in Africa; and (3) discusses future needs and the implications for policy.

Overview of the Fertilizer Situation in Africa

1. Introduction

Never before has so much attention been paid by the African nations and the international community to creating an enabling environment for broad-based economic growth and poverty reduction on the continent. Many African countries have made significant strides in the areas of democratic transitions, political inclusiveness, voice and accountability, and economic management. Revitalized African institutions, such as the African Union (AU), the Economic Commission for Africa (ECA), and the New Partnership for Africa's Development (NEPAD) are taking bold steps to create institutional frameworks for peace and security, regional integration, and the implementation of the policies needed to achieve the Millennium Development Goals (MDGs).

With more than 70% of African people living in rural areas and 75% of them living on less than a $1 per day, it is clear that sustainable increases in agricultural productivity and rural incomes are the basis for broad-based economic growth. That is why a call for action has been sent by Kofi Annan, Secretary General of the United Nations: the time has come for a uniquely African Green Revolution. The central challenge remains how best to create conditions under which farmers can intensify their production systems and increasingly link them to markets. This would entail policies targeted at improving the availability and the quality of resources needed for agricultural intensification: the climate for private sector activity, human and social capacity (agricultural research, health, and education), and rural households' access to legally secure entitlements (land and water), input and output markets, finance, and technology (to increase agricultural productivity).

The circular relationship between food insecurity, hunger, poverty, and low productivity in food and crop production is increasingly understood—hunger leads to low productivity which in turn contributes to food insecurity. Reducing the incidence of hunger is essential to increase agricultural productivity and achieve higher rates of growth. People suffering from hunger are marginalized within the economy, contributing little to output and still less to demand. Investing in reducing hunger is a moral and economic imperative. So the goals of reducing food insecurity and raising agricultural productivity are interrelated (FAO, 2005).

History shows that no region in the world achieved food security and substantial productivity increases without significantly expanding fertilizer use. Greater use of fertilizer is indispensable for an African Green Revolution. The goal of 6% annual agricultural growth established by NEPAD's Comprehensive Africa Agriculture Development Programme (CAADP) supports attainment of the Millennium Development Goals. Yield gains through expanded use of fertilizer and other complementary inputs can enhance household food security and increase rural incomes, which in turn will allow for investments in human capital and technologies to maintain the long-term quality of the soil (Figure 1).

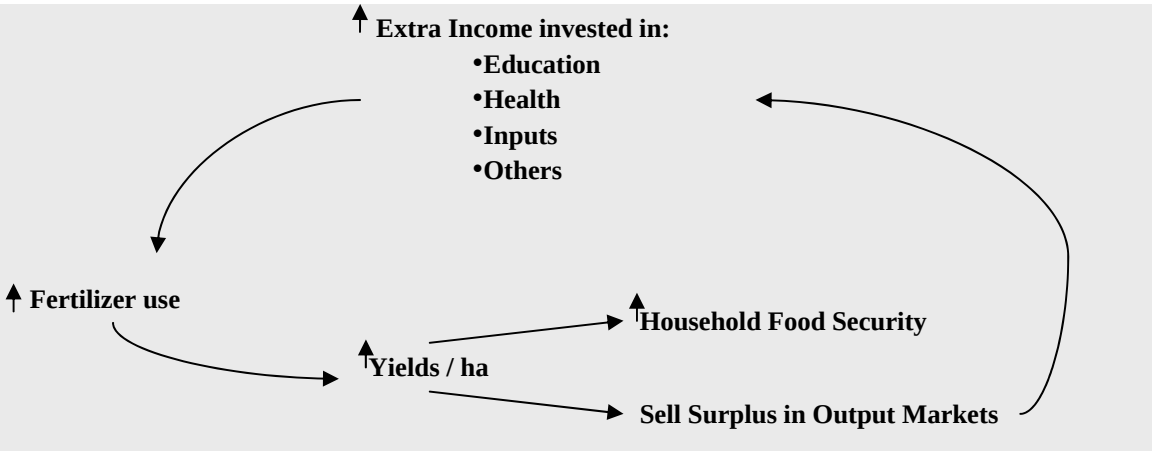


Figure 1. Linkages Between Fertilizer Use and the MDGs

However, increasing fertilizer use among poor smallholder farmers is no small matter in Africa. Governments, donor agencies, and NGOs have tried many different strategies, including direct subsidies on fertilizer prices, distribution of vouchers that can be redeemed for fertilizer, distribution of starter packs for farmers to experiment with fertilizer, and fertilizer-for-work programs. While many of these approaches have achieved some short-term successes, many often collapsed once external funding ended, making them unsustainable over the longer term. The failures of many past interventions to have long-lasting effects on the fertilizer sector can be explained by the many constraints that affect fertilizer supply and use in both commercial and food crop sectors.

To help understand the fertilizer situation in Africa, the remaining sections of this paper (1) describe trends in fertilizer demand and supply, focusing on cross-country differences in fertilizer intensity use and supply levels; (2) examine the evolution of past policies and interventions, their impact on the fertilizer sector, and the factors affecting fertilizer demand and supply in Africa; and (3) discuss future needs and the implications for policy.

2. The Fertilizer Situation

Complexity of the Fertilizer Sector

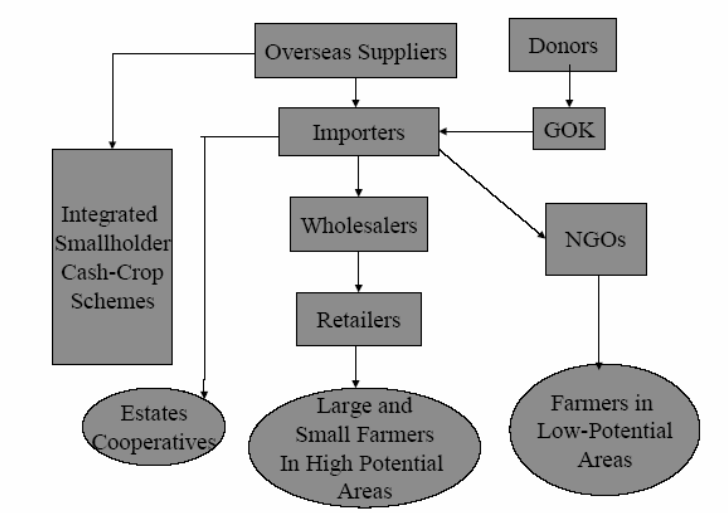
The structure of the fertilizer sector varies from one country to another. Gregory and Bumb (2006) identified, through various IFDC market studies, six fertilizer supply chain systems in sub-Saharan Africa (SSA) (Figure 2). The list is not exclusive, however, and while in some countries there may be only one such system in operation, in a majority of countries a number of different systems coexist.

1 **Domestic Production**	2 **Imported Supply**	3 **Imported Integrated Supply**
Manufacturers | Wholesalers | Retailers | Farmers	Manufacturers | Importers | Wholesalers | Retailers | Farmers	Manufacturers | Export Crop Processors | Farmer Groups | Farmers
4 **Farmer Groups**	**5** **Cooperatives**	**6** **Government Agencies**
Importers | NGOs | Farmer Groups | Farmers	Importers | Cooperatives | Members (Farmers)	Procurement Agency | Distribution Agency | Extension Services or Cooperatives | Farmers

Source: Gregory and Bumb (2006).

Figure 2. Fertilizer Supply Systems in SSA

The complexity of each country's fertilizer sector has also been extensively documented. Wanzala et al. (2001) identified two types of private sector groups involved in Kenya's fertilizer market (Figure 3). The first group is made up of importers, wholesalers, and retailers who sell to farmers. The second group consists of smallholders and large agroprocessors or exporters involved in interlocked input-output market arrangements, as well as large estates, some of which import their own fertilizer directly while others purchase fertilizer directly from private importers (Wanzala et al, 2001).



Source: Wanzala et al., 2001.

Figure 3. The Fertilizer Sub-Sector in Kenya

Actors that play a key role in the fertilizer sector are farmers, producers/importers, distributors (wholesalers, retailers, transporters), and facilitators (marketing agents). In addition to interacting with one another, the various actors operate within a business environment that is affected by a variety of government and socioeconomic forces. Most fertilizer consumed in Africa is imported, and importers are crucial in fertilizer marketing systems. Importers—who may be private, government, or a combination of both—decide the quantity of imported fertilizer for each cropping season based on their assessments of demand, weather conditions, credit availability, and the policy environment (i.e., exchange rates, subsidies). The fertilizer market in most African countries is oligopolistic; the degree of market concentration is very high (i.e., a large percentage of the market is taken up by the leading firms). For instance, the main suppliers of fertilizer in Malawi are YARA, Farmer's World, Agora, Rab Processors, Export Trading and Transglobe. Fertilizer importers usually sell their product to wholesalers, who in turn distribute fertilizers to retailers or directly to cooperatives and large-scale farmers (Jayne et al., 2003). Retailers put fertilizers in smaller, more affordable bags, store them, and provide technical advice to farmers on fertilizer application rates and dosage.

Fertilizers are applied to a range of food and cash crops, according to farmers' assessments of the financial impact of its application. Food crops, and specifically cereals, are the most important crops in Africa in terms of area cultivated (100 million ha, of which 28 million ha maize, 24 million ha sorghum, and 20 million ha of millet) (FAOSTAT); fertilizer is used extensively on these crops. Indeed, in a number of countries the main use of fertilizers is on maize, sorghum/millet, rice, and teff crops. Fertilizers are also applied widely on a range of cash and export crops, ranging from potatoes and wheat to coffee, cotton, and tobacco. The main markets for fertilizers are thus:

- Maize—Egypt, Malawi, Tanzania, Togo, Zimbabwe, South Africa, and Ethiopia.
- Millet/Sorghum—Tanzania, Mali, Niger, Burkina Faso, Senegal, and Nigeria.
- Rice—Egypt, Guinea, Madagascar, Mauritania, Mali, Tanzania, and Senegal.
- Teff—Ethiopia.
- Cotton—Burkina Faso, Mali, Madagascar, Togo, and Zimbabwe.
- Potato—Morocco, Egypt, Kenya, and Madagascar.
- Wheat—Egypt, South Africa.
- Vegetables—Egypt, Mauritania, Kenya, and South Africa.
- Coffee—Kenya, Tanzania, Ethiopia, and Cote d'Ivoire.
- Tobacco—Madagascar, Tanzania, and Zimbabwe.
- Sugarcane—Madagascar and Zimbabwe.

Weak Demand for Fertilizers

The scarcity of data on the nature of fertilizer demand at the country level makes it difficult to assess how much fertilizer is being used by small farmers as against commercial farmers. This information is important for the design of interventions to improve fertilizer use among smallholders to achieve an African Green Revolution.

The role of mineral fertilizer in support of a growing demand for agricultural commodities is well established. The past 30 years show a positive correlation between cereal production and fertilizer use in developing countries, which currently use the bulk of mineral fertilizers and exhibit a faster growth relative to developed countries. Fertilizer is a powerful productivity-enhancing input. Indeed, one-third of the increase in cereal production worldwide

and 50% of the increase in India's grain production can be attributed to fertilizers. However, African production systems are complex and diverse, and can differ significantly from those elsewhere. They often consist of a mix of crops grown simultaneously in order both to optimize use of the most scarce production factor, i.e., labor, and to reduce the risk of crop failure.

In the past, the relatively ample availability of land and low population size resulted in farmers maximizing production per labor unit with rather extensive production systems per unit of land. Only in a situation of land surplus could the need for increased production most easily be accommodated by expanding the area under production. Under such conditions, not surprisingly, input use was low (FAO, 2004). This situation is now changing, and in many parts of Africa there is land scarcity, which means that increased production levels must be achieved through increasingly intensive production systems and higher yields.

Although Africa has 13% of the world's arable land and contains more than 12% of the world's population, its fertilizer consumption (tons plant nutrient) is the lowest in the world. In 2002, Africa accounted for only 3% (or 4 million tons) of the world consumption, compared to 9% (or 13 million tons) and 54% (or 77 million tons) in Latin America and Asia and the Pacific, respectively (Table 1). Almost 70% of Africa's fertilizer consumption is concentrated in North Africa; sub-Saharan Africa, excluding South Africa, accounts for a mere 1% of world consumption (or 1.38 million tons).

Table 1. Fertilizer Consumption in the Global Context—2002

Regions	Total Fertilizer Consumption	Share in World Total	Average Fertilizer Application Rates
	(millions tons)	(%)	(kg/ha)
Africa	4	3	22
North Africa	3	2	76
Sub-Saharan Africa	1	1	9
Asia + Pacific	77	54	148
Latin America + Caribbean	13	9	89
Global totals	142		101

Source: Geo Data Portal.
Note: SSA excludes South Africa.

Even with measures of fertilizer use intensity (kg/ha), which account for differences in cultivated area between countries, the picture remains gloomy. African countries consume an average of 22 kg of fertilizer per hectare of arable land in contrast to 89 kg/ha in Latin America and the Caribbean and 148 kg/ha in Asia and the Pacific. SSA countries, excluding South Africa, consume only 9 kg/ha. In terms of fertilizer nutrient consumption (million nutrient tons of N, P_2O_5, and K_2O), nitrogen fertilizer is the main nutrient used on crops in Africa, representing 64% of total fertilizer consumed, followed by phosphate (24%) and potassium (12%) (IFDC, 2005).

Africa's fertilizer situation is not only characterized by low levels of use by global standards but also by sharp variations between and within countries. In 2002, fertilizer consumption ranged from 0.31 kg/ha for Central African Republic to 437 kg/ha for Egypt

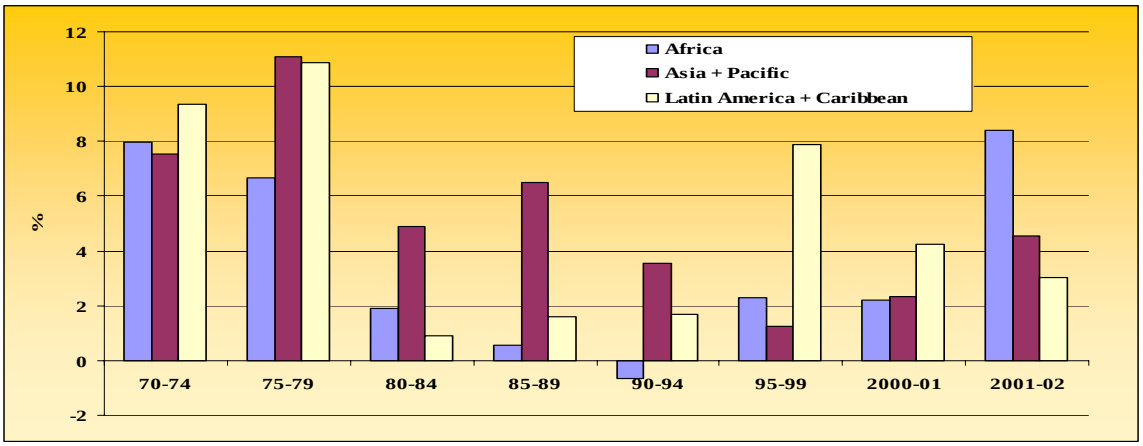
(Figure 4). Fertilizer consumption is highly concentrated, with Egypt and South Africa alone accounting for about 40% of Africa's total fertilizer consumption. Farmers in 33 African countries apply less than 10 kg of fertilizer per hectare of arable land. Countries at the lower end of the spectrum include 7 of the 15 landlocked countries in Africa, namely Burkina Faso, Central African Republic, Niger, Uganda, Burundi, Chad, and Mali.

less than 10		between 10-50		more than 50	
Sao Tome&Principe	-	Zambia	12.39	South Africa	65.42
Angola	-	Botswana	12.43	Mauritius	250.00
Djibouti	-	Algeria	12.79	Egypt	437.52
Liberia	-	Senegal	13.61	**Total**	**752.94**
Eq. Guinea	-	Rwanda	13.71		
Central African Rep.	0.31	Ethiopia	15.10		
Namibia	0.37	Benin	18.76		
Burkina Faso	0.38	Kenya	31.03		
Somalia	0.48	Libya	34.10		
Sierra Leone	0.56	Zimbabwe	34.16		
Gabon	0.92	Lesotho	34.24		
Niger	1.11	Cote d'Ivoire	35.16		
Congo	1.24	Tunisia	36.81		
Congo DR	1.57	Swaziland	39.33		
Tanzania	1.79	Malawi	43.00		
Uganda	1.82	Morocco	47.52		
Burundi	2.58	**Total**	**434.14**		
Madagascar	3.09				
Gambia	3.20				
Guinea	3.56				
Comoros	3.75				
Sudan	4.28				
Chad	4.86				
Cape Verde	5.24				
Nigeria	5.50				
Cameroon	5.86				
Mozambique	5.93				
Mauritania	5.94				
Togo	6.79				
Eritrea	7.35				
Ghana	7.42				
Guinea-Bissau	8.00				
Mali	9.01				
Total	**102.91**				

Figure 4. Fertilizer Use Intensity (kg/ha) by Country, 2002

In recent times African farmers have in fact intensified agricultural production, and fertilizer consumption more than doubled from 10 kg/ha of arable land in 1970 to 22 kg/ha in 2002. In Sub-Saharan Africa it actually increased by 250%, while in North Africa the increase amounted to 215%. Put another way, between 1970 and 2002, fertilizer consumption grew at an annual average rate of 3% in Africa, which does not represent large increases in absolute quantities of fertilizer consumed (Figure 5). Furthermore, this growth rate is far below the 5% in Latin America and 6% in Asia and the Pacific, and it reflects far lower levels of fertilizer use than in the other regions.

During the 1970s, Africa recorded an extremely high growth rate in fertilizer use of between 7% and 8% annually. However, with the onset of structural adjustment policies that resulted in reduced levels of subsidies on fertilizers and the liberalization of fertilizer markets, the rate of growth of consumption declined, to between 1% and 2% annually throughout the 1980s, and by the early 1990s it was actually declining in absolute terms. The situation has since improved, and by 2001-2002, the rate of growth had returned to 8% once more.



Source: FAOSTAT.

Figure 5. Average Percent Change in Global Fertilizer Consumption (%)—1970 to 2002

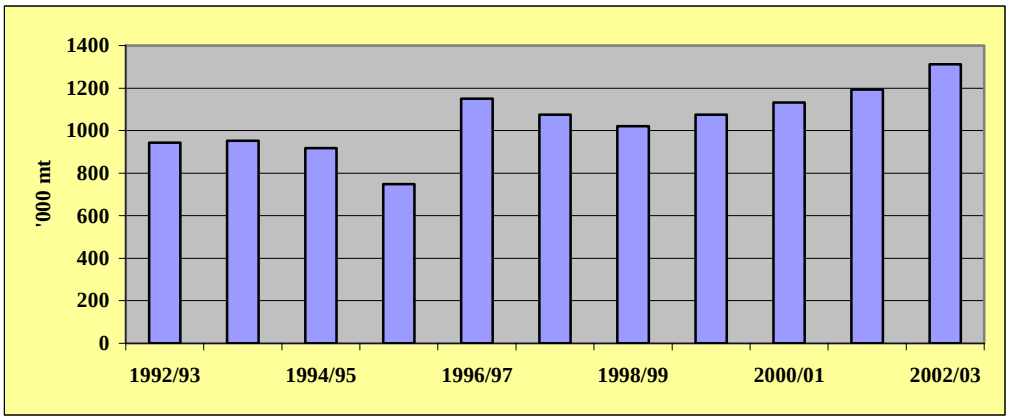
Fertilizer consumption growth rates have fluctuated considerably across African countries. Between 1970 and 2002, twelve countries had negative compound annual growth rates, including war-torn countries such as Congo (-11%) and Sierra Leone (-7%) (Figure 6). Average annual growth in fertilizer use is between 0% and 5% for 19 individual countries, including most of the countries that have the highest absolute levels of fertilizer use. Such countries include Egypt, Morocco, and Tunisia. Countries with the highest growth rates are Nigeria (10%), Togo (11%), Lesotho (12%) and Rwanda (13%).

Negative		between 0 and 5		more than 5	
Congo, Rep	-11.16	Mauritius	0.40	Burundi	5.01
Sierra Leone	-7.03	South Africa	1.17	Benin	5.26
Somalia	-5.34	Gambia	1.27	Mauritania	5.48
Central African Rep	-4.27	Sudan	1.30	Chad	6.52
Tanzania	-4.18	Cameroon	1.40	Malawi	7.56
Madagascar	-2.46	Zambia	1.65	Niger	9.27
Réunion	-1.49	Burkina Faso	1.68	Nigeria	10.36
Algeria	-1.03	Congo, Dem R	2.42	Togo	10.98
Zimbabwe	-0.89	Kenya	2.93	Lesotho	11.67
Guinea	-0.62	Mozambique	3.16	Rwanda	12.58
Swaziland	-0.09	Botswana	3.41		
Uganda	-0.02	Mali	3.31		
		Côte d'Ivoire	3.57		
		Egypt	3.78		
		Tunisia	3.78		
		Morocco	4.14		
		Ghana	4.72		
		Senegal	4.59		
		Libya	4.97		

Figure 6. Compound Annual Growth Rates in Fertilizer Consumption by Country (%), 1970-2002

Underdeveloped Production Capacity and Over-Reliance on Imports

Although Nigeria has large oil and gas reserves and Africa is home to the largest phosphate rock reserves in the world, SSA imports over 90% of the fertilizer it uses (IFDC, 2005). SSA imported close to 1.4 million tons of fertilizer in 2002/03 (Figure 7). Africa is completely reliant on imports for potash fertilizer, and the continent's nutrient production is largely dominated by nitrogen fertilizer (3 million tons or 3% of the world's supply).



Source: IFDC (2005).

Figure 7. Net Imports of Fertilizer in SSA ('000 tons)—1992/93 to 2002/03

The production of N fertilizer is concentrated in 11 countries in Africa: Algeria, Egypt, Libya, Morocco, Tunisia, Mauritius, Nigeria, Senegal, South Africa, Zambia, and Zimbabwe (IFDC, 2005). Egypt is by far the largest producer of N in Africa; however, N production declined in SSA from 407 thousand tons in 1992/93 to only 110 thousand tons in 2002/03.

Phosphate (P_2O_5) is produced in six SSA countries (Burkina Faso, Côte d'Ivoire, Nigeria, Senegal, South Africa, and Zimbabwe) and four North African countries (Algeria, Egypt, Morocco, and Tunisia) (IFDC, 2005). Again, Africa has a small share (3%) of the world's production of P_2O_5 (Table 2). The three biggest producers of phosphate are Morocco, South Africa, and Tunisia. Côte d'Ivoire ceased producing phosphate in 1994/95; Nigeria and Burkina Faso followed in 1999/00 and 2001/02, respectively. Production plants closed in these countries when, against a backdrop of fluctuating world market prices, they failed to achieve the consistently high operating rate that is critical for operating profitability.

Table 2. Global Fertilizer Production (million tons)—1992/93 and 2002/03

Area	1992/93				2002/03			
	N	P_2O_5	K_2O	Total	N	P_2O_5	K_2O	Total
	(million tons of nutrients)							
North America	17	11	8	36	13	8	9	30
Latin America	3	2	0	5	3	2	1	5
Western Europe	9	3	6	18	7	1	5	13
Eastern Europe	4	1	0	5	3	1	0	4
Fr. Soviet Union	10	5	7	22	10	3	8	22
Africa	2	2	0	5	3	3	0	6
Asia	34	10	2	47	47	15	4	65
Oceania	0	1	0	1	0	1	0	1
World	**80**	**34**	**23**	**138**	**87**	**34**	**26**	**147**

Source: IFDC (2005).

3. Policies and Constraints

Evolution and Impact of Fertilizer Policies

In much of Africa, the immediate post-colonial period was characterized by extensive regulations and heavy government intervention in the economy. Typically, the government controlled the import and distribution of fertilizers. According to an FAO survey, state monopolies existed in 30 of 39 African countries surveyed in the mid-1980s. Seasonal finance, input delivery, and sale of output were closely interlinked through state control of agricultural input and product marketing (Crawford et al., 2006). The state distributed fertilizers and other inputs, often on credit, to farmers and recovered loans at harvest time. These systems were characterized by chronic problems of late delivery, inappropriate formulas (N-P-K mixture), excessively large packages for rural producers, and poor quality control, as most governments' marketing boards had no prior marketing experience.

Many governments imposed fertilizer price controls and subsidies in the mid-1970s. Fertilizers were also provided as aid-in-kind by donors, often making up all or a substantial part of fertilizer imports (Crawford and Kelly, 2001). Fertilizer pricing was generally pan-territorial, that is, the same price applied all over the country, irrespective of delivery costs. In addition, the

price did not fluctuate much in the short and medium run, a policy assisted by the fact that many countries pursued a policy of fixed exchange rate (Bumb et al., 1993). Overvalued local currencies provided an implicit subsidy for fertilizer imports, which sometimes received preference in the allocation of scarce foreign exchange (Crawford and Kelly, 2001).

Fertilizer subsidies were applied broadly to reduce the fertilizer market price without attempting to target subsidies to specific groups, and subsidies intended for the poor were often captured by larger farmers (Crawford and Kelly, 2001). Subsidized prices led to a rapid increase in fertilizer demand (7%-8%/year during the 1970s), and this significantly increased the level of fiscal burden on government budgets.

During the 1980s, structural adjustment policies were adopted in many countries. The impact of these policies on the fertilizer sector was mixed. The removal of subsidies on fertilizer was expected to reduce the fiscal burden (and leakages) to governments, while the withdrawal of inefficient parastatal companies from fertilizer marketing was expected to create space for the emergence of an efficient private sector distribution system. This would in turn improve the availability of fertilizers and other inputs; result in lower prices to farmers, more timely supply, and greater variety in fertilizer formulation to meet local requirements; and create the opportunities for production diversification.

In practice, the removal of parastatals that supplied factors of production resulted in an institutional vacuum in support of agriculture. In only a few countries was there a private sector ready to establish fertilizer supply chains into the rural areas, and many farmers found themselves worse off in terms of fertilizer availability, variety, and, above all, prices. To the extent that a private sector did emerge, traders were reluctant to offer farmers fertilizers on credit because of high default risks. As a result, fertilizer use declined in many countries due to decreased access to credit and reductions in the area served. A case study developed by Jayne et al. (2003) for Kenya discusses some of these complexities.

Case Study: Evolution and Impact of Fertilizer Policies in Kenya

Before the reforms, the Government of Kenya (GOK) provided a fertilizer importation monopoly to the Kenya Farmers Association (Jayne et al., 2003). In the mid-1980s, the government tried to encourage other firms to enter the market though under very tight controls (Jayne et al., 2003). For instance, the government determined which firms were allowed to operate, through licensing requirements and the allocation of foreign exchange and fertilizer traders were to adhere to official prices set at 54 market centers throughout the country (Jayne et al., 2003).

By 1993, prices were decontrolled, donor imports dwindled to 5% of total consumption, and small-scale farmers relied exclusively on the private sector and cooperatives for fertilizer (Jayne et al., 2003).

By 1996, there were 12 major importers, 500 wholesalers, and roughly 5,000 retailers distributing fertilizer in the country (Jayne et al., 2003). Currently, the private sector handles nearly 90% of all fertilizer imports.

The number of retailers rose to between 7,000 and 8,000 by 2000. Some of the largest importers were cooperatives and estate firms supplying their members, most of whom were small-scale farmers participating in tea, coffee, and sugarcane outgrower schemes (Jayne et al., 2003).

Beginning in 2002, the government through the National Cereals and Produce Board started to engage in fertilizer trade, importing over 40,000 tons per cropping season. These interventions could discourage private sector investments in the fertilizer sector.

Source: Jayne et al, 2003.

More than a decade later, the situation is changing. Many small farmers are increasingly able to access fertilizers. Private sector supply chains for fertilizers are emerging, particularly in areas that are accessible from the principal cities and that have a sizeable rural population and a substantial market for agricultural inputs. An increasing number of farmers are engaged in contract farming arrangements with agro-processors or exporters who are willing to provide inputs on credit in order to increase the volume of final products that they are able to purchase. These emerging market arrangements are reflected in a new growing demand for fertilizers in Africa.

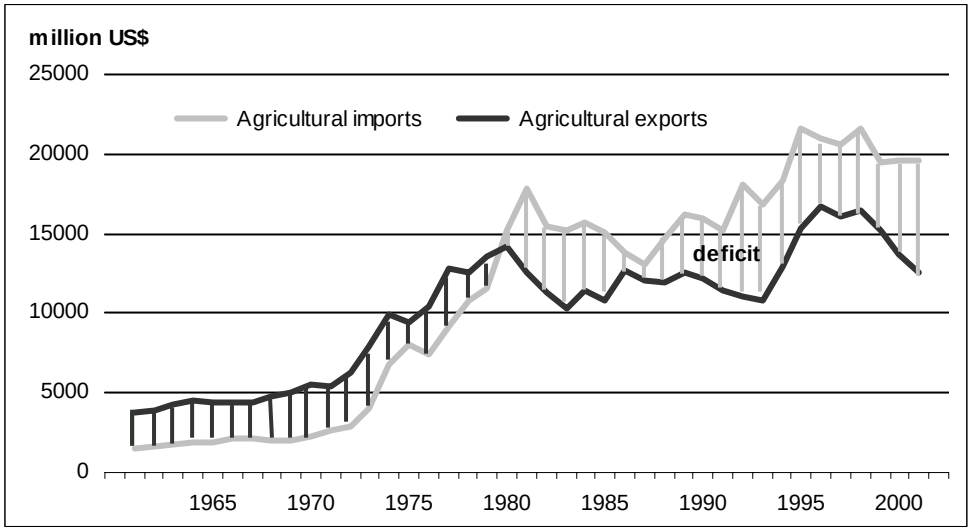
Yet enormous numbers of farmers—particularly those in more remote areas or in areas of low population densities and agricultural potential—are poorly served by the new private sector markets. Accessibility remains weak, choice is limited, and prices are extremely high. There is still much to be done to make these markets work in a manner that is efficient, competitive, and transparent.

For the input supplier and trader too, real difficulties remain, particularly in terms of the policy environment. Since the implementation of structural adjustment programs, the fertilizer sector has been the subject of inconsistent policies and interventions, characterized by changes in government involvement or by unexpected and politically driven government distribution programs. As a result of the uncertainties that this creates, the entry of new commercial fertilizer firms has been limited (FAO, 2003).

Demand-Side Constraints

Profitability of Use—The profitability of fertilizer use, usually reflected in high input/output price ratios, affects farmers' demand for fertilizer. Fertilizer use profitability is a function of technical and economic factors. Soils may be too poor to use fertilizer effectively; there could be an inadequate response from lower grade crop varieties or poor seeds; or farmers may be unable to apply the comprehensive package of complementary practices needed to get the most out of the fertilizer. Economic constraints include the high cost of getting fertilizer to the farm gate (including unavailability in small and affordable packages) at the right time, as well as the low prices farmers receive for their outputs or the late payments for crops delivered.

Commodity Markets—The demand for fertilizer is conditioned by farmers' access to output markets. Markets may not exist at all for some crops (e.g., millet in remote rural areas). Markets may be uncompetitive or even exploitative, or farmers may have to travel exceptionally long distances to access them. Poor agricultural performance in Africa has led to increasing reliance on imported food supplies, including food aid, making the region a net agricultural importer since 1980 and the recipient of more than a quarter of total world food aid (Figure 8). In many countries large-scale imports of agricultural products such as rice have a significant impact on the prices farmers receive.



Source: FAOSTAT.

Figure 8. Agricultural Trade Africa: Surplus to Deficit

Commodity Prices—Generally speaking, an increase in the price of any crop will lead to an increase in fertilizer use. The relative price of output to fertilizer price conditions fertilizer use, which explains why fertilizer use is concentrated on the most profitable crops, be they cash crops such as cotton in Mali and Burkina Faso or food crops such as teff in Ethiopia or maize in Malawi. Commodity prices are a function of the strength of demand for a crop commodity, government price policies, transport infrastructure, storage facilities (to stock grains until prices are higher), market information, and seasonal variability in demand and supply (Yanggen et al., 1998).

Perception of Yield Responsiveness to Fertilizer—Farmers' perceptions about the potential impact of fertilizer on yields (and thus incomes) also affect their demand. Their understanding is influenced by the quantity and quality of information available on fertilizer (dosage, application rate, price, availability) and their access to that information, including extension activities, demonstration plots, observations/experience of other farmers, and crop technologies used (improved varieties).

Fertilizer Price—An increase in the price of fertilizer results in a reduction in the quantity of fertilizer demanded. The farm-gate price of fertilizer is determined by the cost of importing fertilizer, production or processing costs, storage, transport and marketing costs, the degree of competition in the fertilizer market, and the quantity of fertilizer demanded. African farmers pay the highest price for fertilizers around the world.

Table 3 presents the price structure for imported urea in the United States compared with Nigeria, Malawi, Zambia, and Angola in 2003. The ratio of farm-gate price to cost, insurance, and freight (c.i.f.) ranges from 1.42 for the United States to 2.04 and 2.56 for Nigeria and Angola, respectively. Domestic marketing costs are extremely high; in many African countries, these costs account for more than 50% of the farm-gate price of fertilizer (Kelly et al., 2003). Inland transportation costs alone account for 15%, 19%, and 21% of the farm-gate price in Nigeria, Malawi, and Zambia, respectively. Dealer costs and margins range from $16.01/ton in Nigeria to $220/ton in Angola, reflecting risk created by an uncertain policy environment (Kelly et al., 2003). High margins in these countries can be attributed to uncertainty created by frequent but unpredictable government interventions in the market.

Prices and Availability of Substitutes and Complements—The price of different types of fertilizer nutrients, water (irrigation), seed, organic matter, and farm labor can have an impact on the use of fertilizer. For example, water and fertilizer are complements in production—water reduces the risk of fertilizer use and spurs the adoption of high-value crops.

Capacity to Invest—Fertilizer demand is also a function of farmers' capacity to invest in and use fertilizers. Demand is further related to the farmers' understanding of the soil characteristics as well as their access to information, capital, input and output markets, complementary inputs, and institutions.

Table 3. Comparison of Fertilizer Procurement and Distribution and Marketing Costs, 2003 (US $/ton)

Country	United States[a]			Nigeria[b]			Malawi[c]			Zambia[d]			Angola[e]		
Cost Items and Margins		**Cum.**	**Margin**		**Cum.**	**Margin**		**Cum.**	**Margin**		**Cum.**	**Margin**		**Cum.**	**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	326.23	
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 margin	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%
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**	

Source : Gregory and Bumb (2006).

a. United States—Bulk urea imported, transferred to barge, and delivered to a Midwest location.
b. Nigeria—Bulk urea imported to Lagos, bagged at port, and delivered to retail outlets in Federal Capital Territory (Abuja).
c. Malawi—Bagged urea imported through Beira Port, Mozambique, and trucked to Lilongwe, Malawi.
d. Zambia—Bagged urea from Mid-East port imported through Beira Port, Mozambique, and railed to Lusaka.
e. Angola—Bagged 12-24-12 from Portugal by 20-ft container to Luanda and delivered to Huambo by truck.

Notes:
1. All urea f.o.b. prices standardized for comparative purposes with a $10/ton difference in bulk and bagged prices.
2. 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.
3. The Angola data are for NPK 12-24-12 and therefore are not comparable with data for urea for other countries in the table.

Risk—Risk in crop production (weather, pests, diseases), uncertainty concerning fertilizer delivery time, uncertainty about the selling price of output (large fluctuations in output prices; existence of a guaranteed market for output), and weak and uncertain land tenure security are factors that reduce the demand for fertilizer (Reardon et al., 1999). Farmers may have both the knowledge and available resources, but be unwilling or unable to incur the risks of crop losses from adverse weather, pests and diseases, failure of the technology, or income losses from adverse market developments. For example, one risk associated with using fertilizer is the rainfall factor. Fertilizer applied without subsequent adequate rainfall may actually damage the crop by burning the seeds.

Supply-Side Constraints

Risks Associated With Uncertain Policy Environment—The private sector is profit-driven, and the distribution networks for fertilizers, which are a function of market size, degree of competition, and operation costs, follow patterns of effective demand. This situation is often perceived by governments as reflecting the inability of the private sector to supply fertilizer in a cost-effective manner, thus providing justification for intervention. Government and donors' involvement in inputs markets may be direct or indirect: it may include interventions related to foreign exchange rate and availability, interest rates, price controls, subsidies, tenders for importation, and import tariffs and duties. Repeated and unpredictable government interventions, however, create an uncertain environment for the private fertilizer sector. For instance, the Governments of Tanzania and Nigeria continue to provide fertilizer subsidies in selected areas of their countries. The Governments of Madagascar and Zambia directly distributed fertilizers to targeted farmers at half-price. A stable policy environment reduces risks, which is an essential condition for private sector agribusinesses to assume fertilizer marketing functions and develop domestic fertilizer demand.

Institutional Risks—Laws and regulations of direct consequence for fertilizer marketing include registration procedures; packaging and labeling requirements; and quality control measures, including preshipment inspection, and their enforcement. Continuous procedural changes constitute a major impediment for market entry when risk aversion on the part of rural decision makers translates into high cost of fertilizer (traders) and ensuing low demand (farmers).

Insufficient Human Capital—The fertilizer sector is characterized by insufficient and less qualified human capital. This is often manifested in the form of:

- Limited number of importers and wholesalers involved in fertilizer markets.
- Poor spread of input dealer networks in rural areas (distribution of retailer/stockists).
- Weak business and technical capacity of dealers.
- Long distances traveled by farmers to purchase a bag of fertilizer.
- Small number of producer and trader associations.
- Lack of marketing skills and qualified input dealers.
- Weak linkages between input dealers, importers, and wholesalers.
- Lack of proper knowledge about fertilizer products and their profitable use.

Limited Access to Credit—The lack of access to finance constrains the ability of fertilizer importers, wholesalers, and dealers to raise sufficient funds at the opportune time to purchase fertilizer and/or for business development. Lending terms—high interest rates and exhaustive collateral requirements—are unattractive for fertilizer importers and input dealers.

The risk-averse behavior of the banking sectors in Africa towards the agricultural sector may be, in part, the result of a lack of efficient loan recovery enforcement mechanisms.

Lack of Market Information—Information on fertilizer prices, imports and exports, and availability by market and product in Africa is inadequate. It is difficult for importers, dealers, and farmers to plan to address shortfalls or carryover stocks, and hence make sound business decisions, without timely and accurate information on fertilizer prices, availability, and quality. Such information reduces transaction costs via increased transparency in market transactions (IFDC, 2005).

Infrastructure—Infrastructure development is of vital importance for fertilizer availability and to provide farmers' market access for their produce (for each ton of applied fertilizer, at least 15 tons of grain should be transported to the market by the end of the season). Internal transport costs are high in African countries. For example, they increase fertilizer-marketing costs by 33% in Ethiopia. The poor road networks in many countries not only add to fertilizer costs but also create a disincentive to private sector input dealers to expand their outreach to remote villages where they may deliver only small quantities of fertilizers.

4. The Way Forward

To meet NEPAD's goal of 6% annual growth in agricultural production and the first Millennium Development Goal by 2015, the estimated nutrient requirements are 5.6 million tons of N, 1.1 million tons of P_2O_5, and 2.3 million tons of K_2O—a total of 9 million tpy (Henao and Baanante, 2006). For SSA the estimated requirements are 4.1 million tons of N, 800,000 tons of P_2O_5, and 1.8 million tons of K_2O, in total about 7 million tons. This implies required growth in fertilizer application rates of 40 kg/ha in SSA and 47 kg/ha in Africa.

The related effective demand for this volume of fertilizers will depend in particular on whether conditions under which smallholders can intensify their production can be created. To break the high-price and low-demand cycle, the demand and supply constraints to fertilizer use must be addressed systematically and comprehensively by focusing on the following elements:

1. **Designing and Strengthening Policies**—African governments need to build strong institutions to create an environment in which smallholders can intensify their production systems. This can be done through the adoption, implementation and enforcement of policies on access to output markets, land tenure, water, input supplies, and physical and human capital. For instance, African governments no longer monopolize the importation and distribution of fertilizers, and therefore they need to establish sound regulatory systems for fertilizers. African governments need to develop and enforce enabling and consistent laws and regulations to govern the fertilizer industry. Specific attention needs to be paid to credit for farmers and traders/retailers and to quality control laws and their enforcement regarding fertilizer packaging and labeling requirements. Such policies would set fertilizer consumption, production, and marketing in the wider context of agricultural production systems and poverty reduction.

2. **Defining Fertilizer's Role in National Development Strategies**—Any serious attempt to increase fertilizer use in a sustainable manner in Africa must begin with governments acknowledging the importance of fertilizer for agricultural growth by consciously building

fertilizer policy and programs into their national development strategies. By defining the role of fertilizer in their overall national development strategies, governments will be compelled to not only define their role in the fertilizer sector but also to make budget plans for well-designed and targeted programs and interventions in the fertilizer sector. Such an approach will considerably increase the transparency of government programs and reduce risks for importers, distributors, dealers, and farmers arising from uncertainties in the policy environment.

3. **Strengthening Human Capital**—Public investments will be needed to improve (i) agricultural research output (site-specific fertilizer recommendations), (ii) the diffusion of information through better quality of extension services, (iii) dealers' knowledge, and (iv) farmers' management skills and capacity to evaluate, adopt, and safely use and adapt fertilizer to their farming practices.

4. **Reducing Fertilizer Costs**—Governments can reduce fertilizer costs, while at the same time promoting the expansion of private sector fertilizer supply networks, by organizing the consolidation of fertilizer importation orders (regional procurement to capture economies of scale) and by investing in transportation infrastructure.

5. **Improving the Profitability of Fertilizer Use**—Governments, supported by their development partners, can help small farmers increase the profitability of fertilizer use through a range of measures aimed at enabling them to increase their crop yields, to attain better access to output markets, and to engage in them on more equal terms (with better organization and improved information) to realize higher prices.

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