Section 2

Seed and Fertilizer Markets
Tapping the potential of village markets to supply seed in semi-arid Africa: A case study comparison from Mali and Kenya

Melinda Smale1, Latha Nagarajan1, Lamissa Diakité2, Patrick Audi3, Mikkel Grum4, Richard Jones5 and Eva Weltzien6

Abstract
Village markets have potential to supply quality seed in semi-arid areas, but little is known about them. This paper summarizes findings for case studies of village markets for pigeon pea seed in Kenya and millet seed in Mali. In the Mali study, village markets assure a supply of seed of identifiable, locally adapted, genetically diverse varieties as a final recourse in a risky environment where there are as yet no reliable formal channels, for which competitive varieties have not yet been bred, and the potential of agro-dealers to supply certified seed has not yet been exploited. In the Kenya study, well-adapted varieties have been bred, but no formalized channels of seed provision exist for pigeon pea and agro-dealers are active in selling improved varieties of maize and vegetables. In both studies, farm women are major seed trade actors. Vendor characteristics and location in seed program areas, but not price, are significantly associated with quantities sold. Formal and informal systems must be strengthened and linked for non-hybrid, dryland crops in order to exploit opportunities for better diffusion of quality seed, including the seed of both improved varieties and truthfully labeled landraces.

Village seed trade in semi-arid areas of Africa
Many farmers in semi-arid areas of Africa have not yet benefited substantially from growth in agricultural productivity. Improved seed is crucial for achieving growth, along with other productivity enhancing inputs, such as soil and moisture amendments and mineral fertilizer. However, making seed markets work poses unique challenges in these environments, which are often also remote. Seed systems are typically informal, and farmers rely on each other for locally adapted varieties. They are not reliable clients for private seed companies because they purchase seed irregularly. Less improved germplasm has been developed for semi-arid environments because of the high costs of breeding and supplying seed – a situation that has worsened with decreasing public funding for agricultural research.

Periods of seed insecurity occur in remote, semi-arid areas when spatially covariate risk of drought is high and many farmers fall short of seed. During such periods, farmers search for seed in open-air, village grain markets (Tripp, 2001; Sperling and Longley, 2002). Generally, seed transactions in grain markets are considered to be unfavorable because they provide no assurance of seed quality, unlike transactions with other farmers and kin, which are based on trust or direct observation. Procuring seed in grain markets is most often described as a last recourse.

In contrast, a study in Mopti Region, Mali (Sperling et al., 2006) documented that traders in village markets supported seed security by moving the seed of well-adapted landraces from surplus to deficit areas following several years of drought and locust infestation. Landrace identity, often linked to village of origin, was preserved when grain was purchased for seed. Other studies report successful dissemination of modern seed varieties through village trade (Sperling, Loevinsohn and Ntabomvura, 1993; Jones, Audi and Tripp, 2001).

Little is known about seed transactions in village grain markets, which are guided by local technical knowledge and standards, social structures and norms rather than government policies and regulations. The purpose of the exploratory research synthesized here was to better understand their potential to supply diverse, quality seed. We define quality seed as viable, true-to-variety, and including, but not limited to, certified seed of improved varieties. The crops studied – pigeon pea in Kenya, and sorghum and millet in Mali – provide useful points of contrast. While both are grown in semi-arid regions, pigeon pea is a cash crop with emerging export potential; sorghum and millet are staple crops of vital commercial and subsistence importance to the economy of Mali.

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1Melinda Smale, at the time of writing this paper, was a Senior Researcher at Oxfam America. Corresponding author: (melinda.smale@gmail.com)
2Latha Nagarajan: Research Associate, Rutgers University, New Jersey
3Lamissa Dialètè: Sr. Economist, Institut d’Économie Rurale, Bamako, Mali
4Patrick Audi: Research Associate, ICRISAT-Nairobi, Kenya
5Mikkel Grum: at the time of writing the paper was at Bioversity International-Nairobi, Kenya
6Richard Jones: At the time of writing the paper - Asst Director, East and Southern Africa Division- ICRISAT, Nairobi, Kenya. Currently with IFDC, Nairobi, Kenya
7Eva Weltzien : Sr Breeder, ICRISAT-West Africa, Sadore, Niger
8The two studies summarized here are among several studies coordinated by the Agricultural and Development Economics Division (ESA) of the FAO from 2004. A common methodology was designed by FAO staff, project teams and consultants (see Lipper et al., 2010).
Research methodology

The research methodology included four principal elements: (i) an analysis of the seed value chain, (ii) a sample survey of farm households, (iii) a sample survey of vendors in markets most frequented by farm households, and (iv) analysis of genetic diversity of seed samples collected on farms and in markets. This paper focuses on findings from the vendor survey, drawing relevant information from the other research components.

Based on value chain analysis and previous field research, sites were purposively selected in dryland areas where seed projects or programs had been conducted. In Mali, two sites were identified with contrasting amounts of rainfall and market development in the drier, millet- and sorghum-based zones. A self-weighting, random sample of 300 farmers was drawn in 14 villages. The 12 markets in which sampled farmers most frequently participated were identified from the farm survey responses (Douentza, Petaka, Kiro, Kerena, Ngono, Dangol-Boré, San, Dieli, Fangasso, Lohan, Mandiaukuy and Benena). In April 2007, at the onset of the planting season, a rapid vendor census was conducted in each market to identify traders who sold grain for seed as well as for food. A random sample of 102 of traders, stratified by crop and variety or type, was interviewed. Sampling fractions varied by crop and variety but averaged 45%. In Kenya’s Makueni District, markets were also selected to represent a gradient of rainfall in areas and permit comparisons between areas that had benefited from publicly funded seed programs over the last 10 years. A total of 167 vendors, stratified by vendor type, were interviewed during the planting season (October-November, 2006) in seven village markets (Emali, Kalawa, Kasikeu, Kathonzweni, Mulala, Sultan Hamud and Wote), along with 400 farmers in surrounding communities. All shopkeepers and grain traders who sold grain as seed, and all open-air traders in markets where this group numbered less than 15, were interviewed. In markets with more than 15, every other trader was interviewed.

In addition to the vendor survey, vendor lots were purchased from each sampled vendor. Lots were grown out on-station to classify them genetically and link them to samples collected during the farmer survey. An infrastructure survey was also conducted through key informant interviews and direct observation. Team members recorded the general characteristics of the markets, such as product scope, size and physical infrastructure.

Additional details on sampling of vendors and vendor lots can be found in Smale et al. (2008) and Nagarajan et al. (2008). Site maps and descriptions of the protocols used to measure genetic diversity of vendor lots are found in Smale et al. (2010) and Audi et al. (2010). Further information on the seed value chains can be found in Diakité et al. (2008) and Nagarajan et al. (2007). Baseline studies, available from the authors, provided more detailed information about the farmer surveys.

Data reported here are primarily descriptive statistics. Multivariate, ordinary least squares (OLS) regressions were computed to explain variation in quantities supplied by vendors using Stata 9.

Findings

Characteristics of the seed value chain

Sorghum and millet are the major crops of Mali, grown by subsistence-oriented producers in an agricultural sector that is almost entirely rainfed. National average yields for both crops are less than 1 ton per hectare. Low yields are often attributed to low adoption rates for improved seed. The most recent draft Agricultural Census reports that the proportion of cereals area under improved seed does not exceed 10%. Improved varieties of sorghum have been more widely adopted than improved varieties of millet.

Low adoption rates have been blamed on poor performance of the formal seed system. Despite an ongoing process of seed sector reform, liberalization of seed markets for sorghum and millet has not advanced as rapidly as liberalization of grain markets. The formal seed sectors for sorghum and millet continue to be largely state-run, with some participation by registered farmer cooperatives in multiplying seed. So far, commercialization of farmer-produced seed on more than a pilot scale has posed major challenges. At the time of the survey summarized here, no certified sorghum or millet seed was sold in any of the 12 markets studied.

Surpassing the performance of farmers’ own millet and sorghum landraces in the Sahel has been difficult. International and national research centers accelerated breeding efforts from

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1This Mali section draws from Diakité et al. (2008) where a full set of supporting references can be found.
1973, but new cultivars in the dry savannahs made little impact on yields. Of the improved varieties that performed well on research stations during that period, few performed better than landraces on farms, for several reasons. The first is that imported breeding material was unsuitable. Initially, an emphasis was placed on material that was successful in India but was not adapted to the high soil temperatures in the Sahel. The guinea races of sorghum that dominate in Mali differ from the caudatum and kafir races that make up the bulk of sorghum genetic materials grown in other regions of the world. Local sorghum and millet varieties also have photoperiodicity, which enables plants to adjust the length of the growth cycle to synchronize with the length of the rainy season. Unfortunately, early selection programs, combined with the effects of drought, led to the gradual elimination of photoperiodism in favor of a range of varieties with short, fixed cycle lengths.

These shortcomings have since been overcome by international and national breeding programs, but challenges remain. Attaining more than marginal changes in yield is difficult without hybrids, but while promising materials are in the pipeline, none have yet been released for either sorghum or pearl millet. A farmer needs relatively little seed to produce a sorghum or millet crop, which limits the quantities of seed demanded. Decreasing public funding has meant that no breeding is conducted for some agro-ecologies, including that of Douentza, where part of this survey was conducted.

Existing seed legislation in Mali states that only registered varieties may be certified, and the production of seed for commercialization of other varieties without authorization is forbidden. The latest draft law does not appear to forbid the production or sale of unregistered varieties, and stipulates different degrees of qualification that depend on the seed category.

There is no consensus about whether it is lack of effective demand or supply that constrains farmer use of certified sorghum and millet seed. Because the private sector has not taken responsibility for seed distribution, and the public sector has failed to supply improved seed in reasonable quantities, researchers have consistently called for more public research funding and private involvement in seed trade. A few have also called for the development of the informal seed system.

In contrast to Mali, there has been more rapid progress in liberalizing Kenya’s seed sector. Since the 1990s, several international seed companies have entered the national market and more than 50 registered local seed companies have emerged that specialize in seed multiplication and distribution. However, most are oriented toward the needs of farmers in high-potential areas, marketing hybrid maize seed for which there is a regular demand and intellectual property is protected biologically. As a consequence of low profit margins, only a few of these companies sell non-hybrid seed of dryland crops, and when they do, they trade small amounts.

In Kenya, the formal seed sector deals in production and distribution of certified seed only as set out in the Seed and Plant Varieties Act (Chapter 326) of 1991 of the Laws of Kenya. Through this Act, the seed industry regulator, Kenya Plant Health Inspectorate Services (KEPHIS), is empowered to certify seed quality, protect plant breeders’ rights through registration, coordinate the release of superior, well-adapted varieties, accredit and monitor retail outlets for certified seeds. Seeds of maize, pigeon pea, cowpea, beans, sorghum and millets are all subject to compulsory certification under the Act. The process of variety release and certification is lengthy and expensive especially for non-hybrid, improved varieties whose seed can be replanted for several years following initial purchase.

In recent years, pigeon pea, a dryland legume crop, has provided cash opportunities to farmers in semiarid regions in Kenya through its increased export potential, as well as providing food, fodder and fuel for local consumption. However, formal seed sector provision of improved pigeon pea seed is not evident. Pigeon pea growers in Makueni District therefore depend largely on seed programs or unregulated village trade to meet their needs.

The Kenya Seed and Plant Varieties Act neither regulates nor interferes in village trade of pigeon pea, assuming that it concerns grain rather than seed. The Act does prevent traders from labeling and packaging the grain they sell as seed. There are no provisions in the existing Kenyan seed laws to allow the sale of “truthfully labeled” or “quality-declared seeds” of open-pollinated varieties10, but nor are there laws to prevent the informal sale of improved seed by vendors in village markets.

10A more detailed account on FAO system of quality declared seeds can be found at ftp://ftp.fao.org/docrep/fao/009/a0503e/a0503e00.pdf
Site characteristics

The city of San and the town of Douentza are the market hubs of the market clusters identified in each study site of Mali, linked by a 400 km paved road. Farmers in Douentza, located in the Mopti region, rely primarily on millet and cowpea. They can count on only 200-400 millimeters (mm) of rainfall per year. San is located in the Segou region, which is a major producer and exporter of sorghum and millet, with a relatively more diversified cropping system. Rainfall rarely exceeds 600 mm per year. The villages in and around San are known for the grain quality of the millet they sell. Wholesalers in the Douentza town market import and trade the grain from San, as well as lower-quality millet from other regions. Both are suitable only for food because they are mixtures of varieties that are not well adapted to the growing environments around Douentza. The villages in the Douentza site generally trade grain among themselves because this region is less likely to produce a surplus, although there is some evidence that they also trade with drier areas further to the north.

Farming communities in San, although not necessarily individual farmers, are generally self-sufficient in millet and sorghum seed. None of the farmers in San reported having procured seed with cash since the first year growing their varieties; any transactions were gifts or exchanges. Nearly a third of farmers in Douentza reported having procured seed for cash, and the most recent year of seed procurement was 2005 – a planting season that followed two seasons of bad weather and a large-scale locust attack.

Makueni District is one of the three key pigeon pea-growing areas in Kenya, and two-thirds of the district is categorized as arid to semiarid. Farmers grow pigeon pea intercropped with maize and beans. Makueni District benefits from both a short rainy season (October to November) and a longer rainy season (February to May). Although rainfall in the briefer period is poorly distributed (less than 400 mm, on average), it is more reliable than during the longer period. Thus, farmers in Makueni District usually begin sowing major staple crops (maize, beans, sorghum, pigeon pea, and other legumes) at the beginning of the short rainy season.

Most farmers in the region use their own seed stocks for planting. Farmers who have not saved seed from a previous harvest search for seed immediately after the first planting rain, generally during the first week of October. After the droughts that occur every three to five years in the district, farmers depend on village markets for their seed and grain purchases.

Weekly markets serve farmers living within a 50-100 kilometer radius. Those located in wetter areas offer more varieties and handle higher sales volumes than those in dry regions. Markets in the wetter areas are very close to a major paved road connecting Nairobi to the Mombasa port, which enables traders to transport their produce more efficiently. Markets in the drier interior have poorly developed transportation and road networks.

Seed relief programs have become routine following crop failure in this area. Often implemented as a disaster response with minimal planning, the seed type distributed may not be what is most appropriate or needed by farmers. To improve on this practice, since 2002, Catholic Relief Services (CRS) has provided seed vouchers to seed-insecure farmers so that they can procure locally adapted seed at organized seed fairs. This approach works well as long as local seed is available, which is usually the case except where large-scale and prolonged population displacements have occurred.

Seed trade in village markets complements publicly funded seed intervention programs in Eastern Kenya. More than 70% of the seed distributed to farmers through seed vouchers and fairs conducted as part of an emergency seed relief program were sold through local market vendors, and survey data confirm that vendors located in seed intervention areas sold more pigeon pea than those in non-intervention areas.

Market infrastructure characteristics

In Mali, all weekly fairs are conducted during the day from early morning until sunset, and except for the permanent market hubs in the town of Douentza and the city of San, none has electric lighting. Village marketplaces are cleaned by teams hired by the municipality. Formal hygiene control (use of garbage containers, drains, pest control) is minimal. Each village fair in the San site has at least one or two permanent shops and numerous permanent and semi-permanent stalls. Almost no permanent structures were found in the marketplaces of the Douentza site, and semi-permanent stalls were also less numerous.

The difference in market development between San and Douentza sites is pronounced. In the San site, the total number of vendors observed seated on the market floor ranged from...
several dozen to Perhaps 1,000. By comparison, that type of vendor probably numbered less than 200 in each market of the Douentza site. Mobile vendors were also plentiful in the fairs of the San site but rarely encountered in the Douentza fairs. Motorized transport was common in the San marketplaces and largely absent in the Douentza network. Hundreds of horse- and donkey-drawn carts arrived in the Fangasso and Dieli markets of the San site, while at most only about a dozen were observed in each fair of the Douentza site. Wells, pumps or tapped water were present in all the San marketplaces, but in only two of the marketplaces in Douentza.

In Kenya, marketing infrastructure was the most developed in Wote, the administrative and market hub of the district, and the least developed in Mulala village. With the exception of Wote, the markets located in the drier zones of the district (Kathonzweni, Kalawa) had no access to services such as electricity, banking or drinking water, while those in the slightly wetter areas, which also had better access to roads, did. Only Wote provided shaded stalls for non-resident, open-air traders. In all markets surveyed, resident traders had permanent structures, ranging from 10 in Mulala to 18 in Kasikeu. During the survey year, a relatively good year in terms of rainfall, the participation of open-air vendors was highest in Kasikeu (21 traders) and Emali (18 traders) markets in the wetter zones, followed by Kathonzweni (12 traders) in the drier zone. The village markets of Wote, Kalawa and Mulala had the fewest open-air traders. In Wote, certain rules restricted the operations of open-air traders, while Kalawa and Mulala are relatively smaller, retail markets.

**Vendor characteristics**

In either site in Mali, only vendors seated in the open air sold grain as seed\(^{11}\). No certified seed was sold in shops, by agro-dealers or by grain traders, and landrace grain suitable for seed was not sold by grain wholesalers or intermediaries. By comparison, the Kenyan team identified four types of seed vendors operating in the weekly fairs: (i) local shop owners, (ii) grain traders, (iii) farmer-traders and (iv) mobile traders. Agro-dealers, the only vendor type associated with the formal seed sector, traded agro-chemicals and maize or vegetable seeds of proprietary origin, but no pigeon pea.

Vendor characteristics are shown in Table 1. In Mali, virtually all seed vendors (all of whom were open-air vendors) in each site were women. Most vendors in Mali had never attended school,

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<th>Table 1. Characteristics of vendors in village markets of Mali and Kenya</th>
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<td><strong>Percentage of vendors</strong></td>
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<td>Primary occupation</td>
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<tr>
<td>Trading</td>
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<td>Farming</td>
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Source: Authors’ surveys.

*In Mali, denotes statistically significant differences between sites according to either parametric (chi-squared or t-test) or nonparametric test; in Kenya, statistical significance denotes between permanent structures versus open-air traders.

\(^{11}\)Research by Sperling et al. (2006) did identify wholesale traders who kept bags of seed during their seed security assessment, however. This may occur more during years of seed shortage, when demand is high.
and less than 10% stated that they were literate, including those who had attended adult literacy training in their maternal language. Most spoke not only their maternal language but also another local language needed for sales transactions. One vendor spoke French, the official language of Mali. Vendors were typically arranged in the market by affinity (village of origin, ethnicity).

In Kenya, 96% of open-air vendors and nearly three-quarters of all seed traders interviewed were women, and 88% stated they were literate. Educational attainment was higher among shopkeepers and grain traders (10.3 years) than open-air traders (6.6 years). Almost all traders (98%) in the markets surveyed belonged to the Kamba tribe – the dominant tribe of eastern Kenya – and they spoke and conducted the trading mostly in their maternal language. Traditionally, in the Kamba-speaking areas of eastern Kenya, women control the petty trading activities, especially in village markets. Ninety percent of the traders also had working knowledge of Kiswahili, one of the official languages of Kenya. Around 43% of the traders interviewed also could understand English, the other official language of Kenya.

The distribution of primary occupations differed significantly between Douentza and San, which reflects socio-cultural differences. Vendors in the Douentza site, where women are more involved in farming, reported almost unanimously that their primary occupation is farming. Only slightly more than a quarter (29%) of vendors in the San site listed farming as their major occupation, describing themselves instead as housekeepers who help their husbands farm. More than half (57%) of the San vendors reported that trading was their primary occupation, compared with only 5% in the Douentza site.

Major differences in other crops sold are also evident between sites in Mali. More than a third (36%) of vendors in the San site reported a major crop that was neither sorghum nor millet, reflecting the wider range of crops produced in this site as well as the broader range of products sold in the markets. In comparison, 95% of vendors in the Douentza site reported selling millet (83%) or sorghum (12%) as their major crop.

In Makueni District of Kenya, most farmer-traders consider farming their primary occupation. Grain vendors trade throughout the year and have permanent shops, but only sell seed just before the planting season. Farmer-traders and mobile traders transact only during weekly open-air markets. The local shopkeepers and grain vendors traded all year round from permanent structures, whereas farmer-traders and mobile traders traded only once a week during market days, under the open air and with no fixed infrastructure.

In Kenya, increased investment in time and infrastructure further facilitated the specialization of shopkeepers and grain traders in trading. Of the 100 shopkeepers and grain traders surveyed, 73 vendors specialized in trading and considered it to be their primary occupation. They also handled a greater number of crops for sale (an average of five crops) through their shops. All the local shopkeepers surveyed sold grain/seed along with other consumption goods (such as toiletries, vegetables, oil, and matches). The open-air traders handled fewer crops (two on average). Only 33% (of the total 67 open-air vendors) considered trading as their primary occupation, and also considered themselves to be farmers.

Vendors in the Douentza site were slightly younger on average than those in the San site (37 as compared to 47 years). In Kenya, the average age of women open-air traders was similar (44 years) to those in Mali, compared with an average age that is slightly younger (39 years) among shopkeepers and grain traders. In Mali, traders had been selling their products for an average of 11 years. In Kenya, open-air traders had on average an additional year of experience compared to shopkeepers and grain traders (8 as compared to 7 years). Shopkeepers and grain traders explained that they needed more time to establish the minimum infrastructure for trading, which also depended on their initial financial status.

None of the women vendors in the Mali sample, as compared to nearly 44% of the Kenyan sample, owned mobile phones. Ownership by shopkeepers and grain traders were significantly more likely to own mobile phones, as well as other useful assets such as radios and bicycles, than open-air traders (Nagarajan et al., 2008).

Dimensions of access to quality seed

In this section, data describing the dimensions of access to quality seed are presented. Dimensions include (i) availability, (ii) transactions costs and prices, and (iii) information about the grain that signals its suitability for seed. We define availability as the quantity of grain and seed supplied by vendors.
Availability

Estimated amounts of grain and seed sold are shown in Table 2. All physical units of grain (seed) in the Douentza site were sold by the bowl, weighing 0.66 kg on average. Units of sale were larger in the San site (1.2 kgs on average). Total quantities of grain sold in the preceding month were difficult for vendors to estimate. Mean total quantities sold per vendor in April 2007 in the San site were nearly four times as great as those sold in the Douentza site. The quantities reported correspond to sales only within a 2-3 week period, or 2-3 weekly fairs, immediately preceding the expected planting rains. The peak time for seed sales in grain markets includes the period around the planting rains, but can extend later if farmers need to reseed due to an early dry spell that results in germination failure.

In Mali, estimating the amount or share of grain sold as seed, even within a fixed period, was extremely difficult for respondents. Respondents explained that they do not know if a client is purchasing seed unless he or she asks explicitly for seed or quizzes them about the provenance and attributes of the grain. A common response for a year after a good harvest was 2.3 or 2.4 buyers out of 10 are purchasing seed (23-24%), in either site. In years following poor harvests, the estimated percentage was significantly higher in the Douentza site than in San (4.7 compared with 2.9 seed buyers in 10, or 47% to 29%). In both sites the majority of vendors stated that the quantities they sold in the market varied substantially from year to year, depending primarily on the harvests.

Kenyan respondents were better able to estimate the amount of pigeon pea they sold. Both vendors and farmers reported that purchases made during the first two weeks after the onset of the rains were mostly for seed. Despite significant differences in physical infrastructure, there was no significant variation in the amount of pigeon pea supplied and sold among the seven markets surveyed. As might be expected, local shopkeepers and grain traders generally sold significantly more than open-air traders, and mobile traders sold significantly more than farmer-traders—except in the peak season, when all sold an average of only 16 kg/day (Table 2). Traditionally, in dryland environments, farmers or farmer-traders participate in large numbers immediately after the first rains, and transactions are extensive among all trader types.

Costs and prices

Prices for both millet and sorghum were higher in the Douentza site than in the San site, which is not surprising given that the villages are located in a harsher agro-ecology with sparse market infrastructure. Most vendors reported that prices varied by season inversely with the quantities available on the market (Table 2). More than 90% of vendors reported that prices were fixed on the day of the fair by market authorities and cultural norms, and daily variation occurred only in the larger markets. Credit arrangements are rare and usually occur among kin. Discounts were said to be uncommon and granted only to close relatives or friends or when large purchases were made.

In Mali, it was rare for a vendor to have purchased the millet or sorghum she was selling when interviewed (most had brought the grain directly from the family granary). In even fewer cases could a vendor tell us the amount she had paid per unit for grain they purchased and resold. The average markup in 17 cases was 0.83 CFA francs per kilogram.12 In 13 of the 17 cases, the source was known by the vendor and was trusted as a supplier.

Price premiums for millet seed, compared with grain, are rare because seed purchased in the market is procured from grain vendors. Anecdotal evidence suggests that in years of seed scarcity, such as 2005, farmers are willing to pay a premium for locally adapted varieties.

Vendors in the San site, which is larger in scale and scope and where markets are more formally regulated than the Douentza site, pay market fees. Generally, storage at the market was rare. In the smaller village markets of the Douentza site, no fees are charged. The mean market fee paid in Douentza city was higher (100 FCFA), however, than that reported in the San markets (Table 2) – perhaps as a reflection of higher costs of physical infrastructure.

Vendors could not estimate the distance they traveled to the market, but based on their villages of residence, most of them, especially in the Douentza site, appear to have travelled from within a circumference of 5-10 kilometers on foot or in donkey carts. Vendors around the market hubs of San city and Douentza town live in nearby hamlets. Anecdotal evidence suggests that distances may be longer for vendors in the San site precisely because more of them consider their primary occupation to be

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12 Conversion rates on April 15, 2007 from Banque Centrale de l’Afrique de l’Ouest: US$1 = 485.078 CFA franc; 1 CFA franc = US$0.002062.
trading. For example, in Benena market in that site, a group of farmer-vendors had traveled across the border from Burkina Faso.

Hours spent in the market are limited by hours of daylight and the time needed to reach the market. Duration of stay is also influenced by the extent to which the vendor specializes in sales compared with other occupations. We observed that farmers often wanted to sell their millet or sorghum rapidly to make other purchases, conduct other business, and return to the village. Speedy transactions also help them avoid paying fees to sell in the markets. In contrast, vendors more specialized in commerce remained longer hours and often participated in the city markets on days other than the weekly fair, paying the required daily fees.

In Makueni District of Kenya, the average price of pigeon pea lots sold across seven village fairs over the last three years (i.e., 2004-2006) was about 29 Ksh/kg\(^{13}\). The average lowest price of pigeon pea lots sold was 22 Ksh/kg (versus an average high of 40 Ksh/kg) and prices varied significantly among vendor types. The average low price obtained by open-air traders was lower (3 Ksh difference) than that of shopkeepers and grain traders (23 Ksh/kg). Often, during the planting season open-air vendors dispose of their produce early in the day, that is, they settle for lower prices in order to get back to their farming operations. However,

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\(^{13}\)At the time of the survey, the conversion rate was US$1 = 73.6 KSh.
from discussions with vendors, the Kenyan team understood that the average price of pigeon pea sold during the planting season is 10-15% higher than at other times of the year.

The functioning of village markets in Makueni District is governed by permits (i.e., market fees) for the conduct of sales inside the market premises. In principle, payment of a market fee is mandatory for all traders who participate in weekly markets. The amounts collected through market fees are used for the maintenance of market premises. The fee structure is based on sales volume and vendor type. Traders with permanent structures (local shopkeepers and grain traders) were required to buy a license from the local market authorities. Nearly all of the traders (96%) who participated in the weekly markets paid market fees ranging from 10 to 40 Kenyan shillings (Ksh) per day, depending on the market. Eighty-five percent of the traders expressed the view that official procedures were favorable for obtaining a license for trading in the village markets. Although inspection of sales during the market days and in other parts of the year is required by law, implementation is as low as 10% by the market administration. In rare cases, fines were imposed on vendors. Amounts charged ranged between 300 and 1,000 Ksh for irregularities in trading.14

Eighty-seven percent of the vendors interviewed in Makueni District offered the same prices to all buyers; in very rare circumstances, discounts were provided to either friends or relatives. Differences were not significant by vendor type. Across vendor types, only 21% provided some kind of credit or advance to buyers, based on their trust and close association with the client. Credit provision was more prevalent among grain traders than shopkeepers, but no other differences were apparent.

Open-air traders traveled an average distance of 5.8 km to participate in weekly village fairs of Makueni District, on foot (56%) or by public transport. Open-air traders mostly brought their own farm produce (74%). Other vendor types procured pigeon pea from farmers in their own communities and brought it for sale in the fairs. The primary seed sources for local shopkeepers and grain traders were farmers (62%) or their own farms (37%). Only 1% of the total sample (167) procured their pigeon pea from other traders.

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14The most common irregularities were poor sanitation in the trading premises – mice infestation – and presence of grain impurities.
Thus, in Kenya as in Mali, trader margins were not calculable for most open-air vendors. It would also be inaccurate to assign transport and fees to seed sales alone since typically, open-air vendors engage in multiple transactions on the day of the fair.

Information

For grain purchased in village markets to be suitable for seed, clients must know that it will germinate and recognize it as a variety that is adapted to the local growing environment. In the absence of a mutually recognizable variety name, knowing that the grain was brought straight from the seed or grain stores of a farmer in a nearby village is helpful. Seed is more likely to germinate if it has been brought directly from a farmer’s granary; information about local adaptation is conveyed by village name. Near Douentza, particular villages are known for the quality of their seed or for maintaining seed with key attributes – such as early maturity (Sperling et al., 2006).

Farm survey evidence that the seed trade is more significant, and that grain is more likely to be suitable for seed in the Douentza site is borne out by the vendor survey. None of the vendors in the Douentza site mixed their grain (seed) lots, while more than a fifth of vendors in the San site sold mixtures, particularly of sorghum (Table 3). Sorghum mixtures are sold to brew beer.

Vendors in the San site also knew less about the grain they sold. All respondents in the Douentza site reported that they knew the identities of the varieties they were selling compared with only 80% in the San site. Of vendors who knew the identities of the varieties they were selling, more than three-quarters in the Douentza site grew the variety on their own farms, compared to less than half in the San site. Only 6% of lots originated with other traders in the Douentza site compared with over 15% in the San site. In the Douentza site, 84% originated from the fields of the vendor or the granary of the production unit compared with 47% in the San site.

Vendors had been selling their varieties for a longer time, on average, in the Douentza market shed. Nearly 80% of vendors in the San site stated that they generally provided no explicit information about the grain lot to the buyer compared with only 38% in the Douentza site. Many vendors typically provide no information at all unless asked because they do not know the final use that will be made of the seed. Vendors reported that buyers asking about the characteristics of grain are likely to be new to the area or farmers purchasing for seed. Still, even in the case of seed purchases, about one-fifth of vendors told us that buyers know the variety or type by its physical appearance and do not necessarily ask for much information. Often the village of origin is the sole piece of information requested by buyers, or a confirmation that the source of the lot is the village or granary of the vendor.

In the Makueni District markets, 53% of shopkeepers and grain traders interviewed had no prior knowledge or information regarding the seed they sold. However, open-air traders had considerable knowledge. Most of the open-air traders are farmers, and as noted above, brought their own or neighbors’ pigeon pea.

With regard to grain quality control, 33% percent of the vendors in the Makueni site differentiated grain from seed when they

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**Table 4. Information asymmetry in local seed markets of Makueni District, Eastern Kenya**

<table>
<thead>
<tr>
<th>Market location</th>
<th>No of seed lots</th>
<th>Percentage of seed lots classified as pure</th>
<th>Mean difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Vendor information</td>
<td>Agro-morphological information</td>
</tr>
<tr>
<td>Kathonzweni</td>
<td>34</td>
<td>68</td>
<td>39</td>
</tr>
<tr>
<td>Kalawa</td>
<td>12</td>
<td>50</td>
<td>54</td>
</tr>
<tr>
<td>Wote</td>
<td>18</td>
<td>28</td>
<td>11</td>
</tr>
<tr>
<td>Mulala</td>
<td>22</td>
<td>86</td>
<td>57</td>
</tr>
<tr>
<td>Emali</td>
<td>38</td>
<td>84</td>
<td>26</td>
</tr>
<tr>
<td>Kasikeu</td>
<td>48</td>
<td>54</td>
<td>30</td>
</tr>
<tr>
<td>Sultan Hamud</td>
<td>27</td>
<td>68</td>
<td>5</td>
</tr>
<tr>
<td>All markets</td>
<td>199</td>
<td>65</td>
<td>31</td>
</tr>
</tbody>
</table>

procured it. Traders differentiated seed and grain based on physical purity (size, color, and cleanliness of the produce). Consciousness of quality was highest among open-air traders and grain traders (39% each), as compared to local shopkeepers (12%).

In recent years, noting farmers’ preference for small seed/grain packs, traders in the Makueni site have begun to sell small, polythene bags of clean, sorted, farmers’ seed that weigh between 0.5 and 1 kg. This practice is more recognizable among open-air traders (19%) than among grain traders and shopkeepers (14%), and thus among women vendors, who constitute the majority of this group. Farmers prefer the small packs for cost and cleanliness of the produce, although the price difference is negligible (1 to 2 Ksh/kg).

Mixtures were more common among the lots sold by shopkeepers and grain traders, as compared with open-air traders. During the 2006 short rainy season, of the total vendor lots, 35% were identified as “mixtures of unknown varieties,” 21% were identified as “Kionza,” a landrace of medium duration, 8% were “Kikomo,” a landrace with a long growing period, and 8% were “Katoli #40,” an improved, medium-duration type. However, agro-morphological characterization revealed considerable misclassification by vendors. Of the seed lots marketed as recycled-improved by vendors, only 62% were either local or mixed seed types; of the lots marketed as landraces, 42% were improved varieties or mixtures of improved varieties and landraces. Informational asymmetries varied by market (Table 4). Vendors from Kalawa market, who sourced most of their seed from within the village, provided the highest most accurate information on phenotypic purity; vendors from Emali and Sultan Hamud, who sourced most of their pigeon pea from outside the village, provided the least accurate information to their buyers.

**Supplying diversity**

About two-dozen varieties or types of millet and sorghum each were “named” by vendors in the 12 markets studied in Mali. Many of the names mean millet or sorghum “of the people” in various languages or dialects spoken. Only one name referred to a modern variety. Some names include grain color or size, or a description of the panicle (“horse’s tail”). Most often the variety or type originated in a village that was located in the same commune where it was sold. One name refers to a variety retrieved when returning by land from Mecca long ago – perhaps from Chad. Because they convey the ethnic or lineage affiliation of the person selling the grain or seed, names provide more information to Malian farmers than is apparent to outsiders – such as how the sorghum or millet is likely to have been managed on farm as seed or grain, and how it is stored.

A richness of names does not necessarily correspond to the diversity in traits and attributes on which semi-subsistence farmers in semiarid environments depend for production and consumption. In terms of named varieties, the richness of names within markets was also very limited. Names and morphological characterization of samples drawn from vendor lots were used to analyze diversity. While the mean numbers of named varieties per market in the Douentza and San sites were very close (3.17 and 3 respectively), the number of morphological clusters found represented at each market was substantially higher in Douentza (3.83) than in San (2.5). The morphological distinctiveness of the clusters was also greater in Douentza (1.92) than in San (1.1). These results indicate that substantially more genetic diversity was supplied to farmers in the village markets of the Douentza site.

In the Makueni District site, a total of 198 pigeonpea lots were on sale by vendors at the time of the survey. Of the total pigeonpea lots sold, local shopkeepers and grain traders stocked more lots (122) than did open-air traders (76). The maximum number of pigeon pea types (12 named plus mixtures) was sold in the Mulala market, and the least were sold in Kalawa and Wote markets (only two types in each). Mulala village is one of the few villages in Makueni District that has benefitted from ICRISAT- and KARI-led farm demonstration trials over the last two decades, which may be one reason for the higher observed pigeon pea diversity.

Although Shannon diversity indices constructed from variety names did not reveal significant differences among markets, those constructed from agro-morphological data confirmed statistically greater pigeon pea diversity in Mulala market, where market infrastructure is the least developed. Further, computed values of indices based on named types overrepresented agro-morphological diversity.

**Regression analysis**

In Mali, the regression analysis confirmed that vendor characteristics are statistically significant determinants of quantities sold (Table 5). Site was significantly correlated with major crop sold and vendor ethnicity, and quantities sold were
Table 5. Factors affecting total quantities of millet and sorghum sold by vendors in village markets of Mali, April 2007

| Variable                  | Definition                                                                 | Coefficient | Standard Error | t-value | P>|t| |
|---------------------------|---------------------------------------------------------------------------|-------------|----------------|---------|-------|
| Constant                  | Regression intercept                                                      | 176.79      | 97.37          | 1.82    | 0.073 |
| Market hub                | San city,Douentza town = 1, else 0                                        | –17.32      | 33.99          | –0.51   | 0.612 |
| Site                      | San site = 1, Douentza site = 2                                            | –171.12     | 37.43          | –4.57   | 0.000 |
| Project village market    | Market frequented by farmers sampled in project villages                   | 98.96       | 30.36          | 3.26    | 0.002 |
| Time selling              | Hours per day multiplied by number of days vendor sells in this market fair and others | 0.30        | 0.06           | 5.24    | 0.000 |
| Expected price            | Calculated as the mean of a triangular distribution elicited from vendor (minimum, maximum, mode) | 0.81        | 1.02           | 0.79    | 0.431 |
| Age                       | Estimated age of vendor                                                    | –1.94       | 1.00           | –1.95   | 0.055 |
| Education                 | Number of years vendor attended school                                    | 14.84       | 8.49           | 1.75    | 0.084 |

Note: Site, dominant ethnic group and crop sold are significantly correlated and only the site variable was included to represent the three variables. Whether the crop sold was sorghum or millet is not statistically significant. N=88.

lower in the Douentza site. The total time spent selling in the site, a measure of specialization in commerce as compared to farming, positively affected quantities sold; younger and more educated women sold more on average. Quantities sold are not responsive to expected prices during the period, which is consistent with the evidence that most prices are fixed and determined by a combination of social norms among market participants and institutional norms in any given market.

More grain was sold in markets frequented by farmers who participated in a project whose goal was to strengthen local seed systems through farmer field schools and seed fairs.

In Kenya, as hypothesized, vendors located in weekly markets closer to communities where there were seed-based intervention programs in place traded greater quantities of pigeon pea (Table 6). Among vendor types, grain traders in the village fairs dominated through their sheer volume of sales, higher investment, and storage capacity. However, it is not clear if they sold more seeds than open-air traders, especially during the planting season. As in Mali, more educated vendors (although the effect of age was weak), and those with more specialization in trading, sold more. Quantities sold were not responsive to expected prices as most of these prices were the same for different types of pigeon pea sold and prices were fixed on the market day. Overall, the ownership of mobile phones was not a significant factor influencing the sale of pigeon pea in the weekly markets, although there was a significant, positive association between mobile phone ownership and sales by grain traders and local shopkeepers. Many open-air traders (30%) during the survey gave a mobile phone number as their point of contact, which denotes the growing interest in exchange of market related information.

Conclusions

In Mali, village markets assure a supply of seed of identifiable, locally adapted, genetically diverse varieties as a final recourse in a risky environment where there are as yet no reliable formal channels and for which competitive varieties have not yet been bred. The San site, with the better developed market infrastructure, has more active grain markets, produces grain that is known for its high quality in consumption, and serves farming communities that are more likely to be self-sufficient in seed of sorghum and millet landraces. In these markets, grain trade by wholesalers and intermediaries dwarfs grain trade by petty vendors, and grain sold by petty vendors is less likely to be suitable for seed. The potential of agro-dealers to supply certified seed has not yet been exploited. At the time of this research, the major actors in the village market seed trade were farmwomen with little to no formal education, selling grain from their family stores as a means of procuring other supplies. Social structure, agro-ecology and vendor characteristics determine
quantities supplied rather than price, which is influenced for local market institutions and social norms, varying considerably over time but very little by vendor on any given day. There is some evidence that location in areas of seed projects is positively associated with quantities sold, but the potential for bias due to purposive placement has not been fully addressed.

In Kenya, no formalized channels of seed provision exist for non-hybrid, improved seed of dryland cereals and legumes such as pigeon pea sold in the village markets of Makueni District. Agro-dealers are active in selling only improved varieties of maize and vegetables. Shop-owners, grain traders, farmer-traders and mobile traders sell pigeon pea as seed. Most are also women, but more consider their primary occupation to be trading than in Mali and they are considerably more educated. Shop-owners and traders have more assets and are more likely to have cell phones than traders in the other two groups and also sell more pigeon pea, but farmer-traders and mobile traders know more about what they are selling and provide more information to clients. There is variation in the integrity of varieties among markets, and the greatest diversity is found in Mulala, where market infrastructure is least developed. As in Mali, vendor characteristics and location in seed program areas, as compared to price, are significantly associated with quantities sold. The longer history of seed interventions in these sites relative to the sites in Mali supports this statistical result, although as in Mali, defining treatment and control areas with multiple scales of analysis and parameters was difficult.

Table 6. Factors affecting total quantity of pigeonpea sold by vendors in village markets of Makueni District, November 2006

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Coefficient</th>
<th>Standard error</th>
<th>t-value</th>
<th>P &gt; t</th>
</tr>
</thead>
<tbody>
<tr>
<td>Expected price in Ksh*a</td>
<td>Calculated as the mean of a triangular distribution of prices elicited from the vendor (minimum, maximum, and mode)</td>
<td>0.3581</td>
<td>0.3309</td>
<td>1.08</td>
<td>0.281</td>
</tr>
<tr>
<td>Distance*a</td>
<td>Km traveled to the nearest large market town from the weekly market</td>
<td>0.3701</td>
<td>0.1131</td>
<td>3.27</td>
<td>0.001</td>
</tr>
<tr>
<td>Education</td>
<td>Years vendor attended school</td>
<td>0.0581</td>
<td>0.0166</td>
<td>3.51</td>
<td>0.001</td>
</tr>
<tr>
<td>Age*a</td>
<td>Age of the vendor (years)</td>
<td>0.3629</td>
<td>0.2375</td>
<td>1.53</td>
<td>0.129</td>
</tr>
<tr>
<td>Time selling</td>
<td>Number of hours per day multiplied by number of market days participated by the vendors in weekly markets</td>
<td>0.0056</td>
<td>0.0034</td>
<td>1.68</td>
<td>0.096</td>
</tr>
<tr>
<td>Mobile phone</td>
<td>Ownership of mobile phone: (1=yes; 0=no)</td>
<td>0.0881</td>
<td>0.1866</td>
<td>0.47</td>
<td>0.638</td>
</tr>
<tr>
<td>Seed quality</td>
<td>Ability to differentiate seed from grain (1=yes; 0=no)</td>
<td>-0.1765</td>
<td>0.1431</td>
<td>-1.27</td>
<td>0.219</td>
</tr>
<tr>
<td>Weekly markets location*b</td>
<td>Location of market in area with producer marketing group intervention</td>
<td>0.2508</td>
<td>0.1384</td>
<td>1.81</td>
<td>0.072</td>
</tr>
<tr>
<td></td>
<td>Location of market in area with no seed-based intervention</td>
<td>-0.7270</td>
<td>0.3302</td>
<td>-2.2</td>
<td>0.029</td>
</tr>
<tr>
<td>Type of the vendor*c</td>
<td>Local shopkeeper (n = 64)</td>
<td>-0.2896</td>
<td>0.1802</td>
<td>-1.61</td>
<td>0.11</td>
</tr>
<tr>
<td></td>
<td>Open-air trader (n = 67)</td>
<td>-0.2812</td>
<td>0.1708</td>
<td>-1.65</td>
<td>0.102</td>
</tr>
<tr>
<td>Constant</td>
<td>Interceptor</td>
<td>0.6867</td>
<td>1.6568</td>
<td>0.41</td>
<td>0.679</td>
</tr>
<tr>
<td>Number of traders</td>
<td>167</td>
<td>F(11,155) 8.5</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R-squared</td>
<td>0.321</td>
<td>Prob &gt; F 0.000</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: One hundred sixty-seven vendors from seven markets interviewed during October–December 2006 short-rains season.

*a Denotes variables that have been transformed into their natural logarithm values.

*b The omitted category is markets located in community-based seed production programs implemented in Sultan-Hamud, Kalawa, and Kasikeu village communities. The communities located in Wote did not have any seed-based programs, whereas communities located in Kathonzweni, Mulala, and Emali had producer marketing groups.

*c The omitted category of vendor type is grain traders (n = 36).
Policy recommendations

Formal and informal systems must both be strengthened and linked for non-hybrid, dryland crops in order to exploit opportunities for better diffusion of quality seed, including the seed of both improved varieties and landraces. Although it is obvious that public, private, and voluntary actors will contribute to seed system development, especially in supplying seed of staple crops such as sorghum and millet, the optimal innovation system will depend on the context. Some general recommendations follow from the case studies presented and underlying research.

Both investments and changes in legislation are needed to better meet farmer needs in semiarid areas. With respect to investments, more public research funding for plant breeding remains necessary. For example, Mali’s sorghum and millet breeding programs have so little funding that they have had to abandon some target ecologies. More effort should also be directed to involving the private sector at various nodes in the seed supply channel. In addition, the formal sector should leverage the social capital of existing farmer groups to test, evaluate, produce and disseminate improved seed. Public investments are needed to improve power and infrastructure in village markets. Public provision of information is important to support broad market participation because both informal social networks and more formal associations are exclusive. In order to reduce transactions and operating costs, ways of providing credit to traders should be examined.

With respect to legislation, the release procedure for improved seed should be shortened to two years or less. Government should coordinate among implementing agencies to monitor seed relief and protect farmers and seed systems (formal and informal) from poorly conceived seed aid practices. To improve the supply of well-adapted varieties from either farmer-selection or formal research, national legislation should be amended to enable production and sales of truthfully labeled and quality declared seed in village markets. To protect participants in village markets against misguided practices, traders need clear rules and regulations.

Seed policy should help to promote more efficient informal systems in semi-arid areas. In village markets, mechanisms must be designed to improve the quality as well as increase the range of quality-declared seed supplied. Seed fairs help stimulate demand and circulate seed of various types, as do small seed packs and vouchers that are provided to traders in exchange for new seed. Both case studies identify open-air traders, most of whom are women, as sources of relatively good quality seed and related information. Vendors should be linked to seed sources such as seed programs and producer groups, and trained about seed. Traders and farmers need to be informed about the benefits of differentiating seed from grain. Trader associations might enable petty vendors such as the women interviewed to better meet the needs of their clients, especially if they are linked to producers of quality seed or are themselves organized and trained to produce quality seed.

A number of approaches have been piloted recently, and these are potential candidates for improving the supply of quality seed on a larger scale. The West Africa Seed Alliance (WASA) and Eastern and Southern Africa Seed Alliance (ESASA) seek to foster the expansion of existing seed companies and creation of new seed companies through supporting local entrepreneurship. Since private seed companies do not yet operate in the sorghum- and millet-based systems of the Sahel and state agencies are underfunded, ICRISAT has tested several models that draw on the comparative advantages of farmer organizations. Private, foundation seed companies that operate at cost to supply certified seed to farmers’ organizations or traders are one model (Tripp, 2006). In early 2006, ICRISAT supported the production of foundation seed of various modern varieties of millet and sorghum in Niger. The foundation seeds multiplied were distributed through five different mechanisms: (i) farm trials and demonstrations; (ii) direct sales through input shops, agro-dealers and other outlets; (iii) seed fairs, at which seed was available in exchange for vouchers or cash; (iv) free distribution to vulnerable farmers; and (v) seed multiplication by farmers associated with FAO’s community based seed project. Direct seed sales were found to be the most effective seed dissemination mechanism (Longley et al., 2008). Farmer organizations in Burkina Faso received training in marketing certified seed. Recently they have begun selling sorghum seed directly to input traders and emerging seed companies anxious to build their input distribution network. Two farmer organizations in Burkina Faso collaborate with the national agricultural research institution to produce foundation seed and certified seed under close supervision by researchers. The seed is distributed to other organization members for production of certified seed. This approach enables farmers to have access to a much larger range of varieties than can be provided strictly by the national system.
References


Challenges of the maize seed industry in eastern and southern Africa: A compelling case for private–public intervention to promote growth

Augustine S. Langyintuo, Wilfred Mwangi, Alpha O. Diallo, John MacRobert, John Dixon and Marianne Bänziger

Abstract
Following the liberalization and restructuring of the seed sector, the maize seed industry in eastern and southern Africa has witnessed a proliferation of private seed companies. Whereas the total number of registered maize seed companies in major maize-producing countries increased four-fold between 1997 and 2007, the quantity of seed marketed barely doubled, suggesting that the seed production and deployment environment is less than perfect.

A study involving over 92% of all seed providers in east and southern Africa in 2007 showed that a number bottlenecks affect the entire maize seed value chain. The lack of access to credit constitutes a significant barrier to entry. Until governments and development partners make credit available to seed entrepreneurs directly or through risk sharing arrangements with commercial banks, national seed companies will not grow leaving the seed sector monopolized by the regional and multinational seed companies. In addition, the transfer of genetic materials between public and private sectors should be improved to allow easy access by seed companies to suitable and adapted varieties.

To allow for rapid regional spillovers of varieties released in one country to similar agro-ecologies in different countries, the implementation of harmonized regional seed laws and regulations should be expedited. Finally, the best strategies that increase the adoption of improved maize varieties should be explored and implemented to enhance seed demand.

1 The full article is accessible online for a fee at: http://dx.doi.org/10.1016/j.foodpol.2010.01.005.
2 Alliance for a Green Revolution in Africa (AGRA), Eden Square Block 1, 5th Floor, P.O. Box 66773, 00800 Westlands, Nairobi, Kenya (Formerly of International Maize and Wheat Improvement Center (CIMMYT) – Zimbabwe). Corresponding author (alangyintuo@agra-alliance.org)
3 CIMMYT – Zimbabwe, P.O. Box MP 163, Mount Pleasant, Harare, Zimbabwe
4 CIMMYT – Zimbabwe, P.O. Box MP 163, Mount Pleasant, Harare, Zimbabwe
5 CIMMYT – Kenya, P.O. Box 1041 Village Market, 00621 Nairobi, Kenya
6 Australian Center for International Agricultural Research (ACIAR), GPO Box 1571, Canberra ACT 2601, Australia (Formerly of CIMMYT – Mexico)
7 CIMMYT – Mexico, Km 45 Carretera Mexico-Veracruz, CP 56130 El Batan, Texcoco, Mexico
Abstract

Most fertilizer markets in Africa have been liberalized to some extent and there is increasing government recognition of the important role of the private sector in the input marketing system. Nevertheless, fertilizer consumption in Africa remains low and fertilizer markets are small. The establishment of efficient and effective private sector-led fertilizer markets in Africa faces a number of key challenges and constraints on both the supply and demand sides, and overcoming them will require a range of well thought out and carefully implemented policy responses. Identifying these constraints and proposing the appropriate policy responses is the main purpose of this paper. The paper uses the modified industrial organization (I-O) approach to analyze the fertilizer market in Africa, elaborates the supply and demand constraints to its performance, and makes recommendations for policy responses. The key supply side constraints are policy and regulatory uncertainty, limited access to finance, and high inland transportation costs.

The demand side constraints consist of limited fertilizer adoption due to the absence of stable output markets for increased production, weak or non-existent extension systems and outdated fertilizer recommendations. The paper proposes strategic interventions by the public and private sectors that will achieve efficiency gains in the fertilizer supply chain by reducing costs and margins and eliminating bottlenecks, thus making fertilizer marketing more efficient. It also proposes strategic interventions on the demand side to help create demand in a way that is commercially sustainable. The paper draws four key conclusions. First, structure and conduct are not the main characteristics that explain performance in the African fertilizer market. A basic condition of the fertilizer market in Africa, namely the poor transportation infrastructure, has a defining impact on market behavior and hence on performance. Second, research is required to quantify the intangible costs incurred as fertilizer moves from the port to the farm gate. The findings can provide a solid basis for policy recommendations aimed at reducing transaction costs and improving the performance of fertilizer supply chains in Africa. Third, there is a need to reorient fertilizer subsidy programs, which are increasingly popular among African governments, to provide purchasing power support to resource poor farmers. Fourth, the policy environment remains uncertain and non-conducive to well-functioning fertilizer markets in many African countries. Supportive, stable, market- and farmer-friendly policies should be implemented.

Introduction

Fertilizer markets refer to buying and selling, the economic incentive structure and the supply chain from the point of production/importation through distribution to the final consumer (the farmer). Highly functioning fertilizer markets have been recognized as a prerequisite for the success of efforts to improve agricultural productivity and hence increase agricultural output and farm income in Africa. The era of exclusive importation and distribution by state-owned enterprises and large donations of fertilizers from donors is largely over. Most fertilizer markets in Africa have experienced some degree of deregulation and liberalization and there is increasing recognition from governments that the private sector has a role to play in helping meet the needs of the farming community in general and smallholder farmers in particular. Despite these developments, fertilizer consumption in Africa remains low and fertilizer markets are small. Smallholder farmers still lack access to affordable fertilizers of the correct type, in a timely manner and from distribution points that are at reasonable walking distance. As a result, many governments have begun to rethink their decisions to withdraw from fertilizer markets – either the policy reforms have not been fully implemented or there have been policy reversals. However, it must be recognized that the establishment of efficient and effective private sector-led fertilizer markets in Africa faces a number of key challenges or constraints, on both the supply and demand side, and overcoming them effectively will require a range of well thought out and carefully implemented policy responses. Identifying these constraints and proposing appropriate policy responses is the main purpose of this paper.

Africa’s fertilizer market in the global context

The majority of fertilizer consumed in Africa is imported. Conversely, Africa as a whole is a net exporter of fertilizer. Therefore, African fertilizer markets must be analyzed within...
the global context of fertilizer markets, that is, the constraints identified and policy responses recommended must take global considerations into account. Therefore, this paper will begin with an assessment of demand and supply conditions for fertilizer markets in Africa in the global context before focusing on analysis at the continental level.

**Demand for fertilizer in Africa and the global context**

Fertilizer consumption in Sub-Saharan Africa (SSA) has fluctuated considerably since 1980 (Figure 1). Consumption showed an upward trend between 1980 and 1990 reaching around 1.5 million metric tons per year (mtpy) in 1989/90, but after 1990 it exhibited a definite downward trend. Average fertilizer consumption in SSA decreased by 3%, from 1.1 million mtpy in 1995/96 to 1 million mtpy in 2005/06. Therefore, total consumption has not changed significantly between 1980 and 2005/06, averaging 1 million mtpy. Egypt, South Africa and Morocco are the leading fertilizer consuming countries in Africa as a whole; they consumed 3.2 million metric tons (mt) of nutrients and accounted for 69% of Africa’s total fertilizer consumption in 2005/06. In global terms, fertilizer nutrient consumption was 161.4 million mt (2005/06) of which Africa accounted for only 3% or 4.7 million mt (Table 1).

![Figure 1. Sub-Saharan Africa: total NPK consumption, 1980–2006](image)

*Source: Derived From FAO data.*

**Table 1. Fertilizer consumption in Africa and the world ('000 tons NPK)**

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td>137.8</td>
<td>129.7</td>
<td>135.2</td>
<td>169.8</td>
</tr>
<tr>
<td>East Asia</td>
<td>36.5</td>
<td>45.3</td>
<td>45.0</td>
<td>68.3</td>
</tr>
<tr>
<td>South Asia</td>
<td>15.2</td>
<td>18.1</td>
<td>21.5</td>
<td>24.7</td>
</tr>
<tr>
<td>South America</td>
<td>5.0</td>
<td>3.5</td>
<td>9.5</td>
<td>12.7</td>
</tr>
<tr>
<td>Africa Total</td>
<td>3.6</td>
<td>3.5</td>
<td>3.9</td>
<td>3.8</td>
</tr>
<tr>
<td>Africa % Share in World</td>
<td>2.6</td>
<td>2.7</td>
<td>2.9</td>
<td>2.2</td>
</tr>
<tr>
<td>North Africa</td>
<td>1.7</td>
<td>1.6</td>
<td>1.9</td>
<td>2.0</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>1.2</td>
<td>0.7</td>
<td>1.2</td>
<td>1.1</td>
</tr>
<tr>
<td>South Africa</td>
<td>0.8</td>
<td>31.4</td>
<td>0.7</td>
<td>0.7</td>
</tr>
<tr>
<td>SSA % in Africa</td>
<td>33.3</td>
<td>31.4</td>
<td>30.8</td>
<td>28.9</td>
</tr>
</tbody>
</table>

*Source: International Fertilizer Development Center (IFDC)*
Africa's small share of global fertilizer consumption is a reflection of its small fertilizer markets, particularly in SSA. Out of the 44 countries in Sub-Saharan Africa, only nine use more than 50,000 nutrient tons; 10 countries use less than 10,000 nutrient tons (Table 2). These small fertilizer markets are a function of the low fertilizer use per hectare. Average fertilizer use in Africa is 10 kg/ha, equivalent to 10% of the world average, and almost 20 times less than the average for Asia (191 kg/ha) and nine times less than the average for Latin America (94 kg/ha) (Figure 2). Low fertilizer use per hectare does not auger well for achieving food security or reversing severe soil nutrient depletion in Africa. Declining nutrient consumption and low fertilizer application rates have translated into cereal crop yields per hectare for Africa and SSA that are much lower than the world average (3.26 mt/ha) (Figure 3) and lower than what farmers are capable of achieving under conducive conditions. Nevertheless, it should be noted that during 1995/96 and 2005/06, cereal production and cereal yields increased by 18% in SSA – from 956 kg/ha to 1.16 mt/ha – indicating a growing efficiency in nutrient use.

Table 2. Sub-Saharan Africa: distribution of countries by the level of fertilizer use, 2005/2006 annual average

<table>
<thead>
<tr>
<th>Fertilizer use (nutrient tons)</th>
<th>Number of countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 10,000</td>
<td>10</td>
</tr>
<tr>
<td>10,000 – 30,000</td>
<td>3</td>
</tr>
<tr>
<td>30,000 – 50,000</td>
<td>4</td>
</tr>
<tr>
<td>50,000 – 100,000</td>
<td>6</td>
</tr>
<tr>
<td>100,000 – 150,000</td>
<td>1</td>
</tr>
<tr>
<td>Over 150,000</td>
<td>2</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>26</td>
</tr>
</tbody>
</table>

Source: IFDC From FAO data (no data for 18 countries).

Source: Derived From FAO data.

Figure 2. Per hectare fertilizer use by markets, 2006/2007 (kg/ha)
Fertilizer production in Africa and the global context

Fertilizer production on the African continent is concentrated in North and South Africa. Production in SSA is extremely small, although there is some production starting up in Nigeria and forecasted for Tanzania and the Democratic Republic of Congo (DRC). A key reason for the lack of production is that SSA is largely deficient in the natural gas and raw material resources (phosphate rock, sulfur and potassium salts) required to produce fertilizer. Although there are numerous small deposits of phosphate rock throughout SSA, substantial commercial deposits are found only in Tanzania, Togo and Senegal. The DRC is the only country in SSA with commercial deposits of potash. Nigeria, Angola, Equatorial Guinea, Ethiopia, Mozambique, Namibia, DRC, Madagascar and Tanzania are the only countries with natural gas. In comparison, there are significant phosphate rock deposits in South Africa and the country produces 90% of its phosphate fertilizer requirements and imports the rest. It does not produce potassium fertilizers. In North Africa, Morocco, Tunisia, Algeria and Egypt have substantial sources of phosphate rock and natural gas and produce both phosphate and nitrogen fertilizers.

![Figure 3. Cereal yields per hectare by regions, 2006/2007 (mt/ha)](image)

![Figure 4. The fertilizer market in Africa: structure, conduct and performance](image)
Total nutrient production in Africa was 5.5 million mt in 2005/06, an increase of 13% from the 4.9 million mt produced in 1995/96. However, this gain was offset by a 75% decrease in production in SSA – from 0.3 million mt to 0.09 million mt – during the same period. In terms of Africa’s share of global fertilizer production, in 2005/06 the African fertilizer industry produced 3% of the world’s total production of 164.9 million, which is similar to its share 10 years previously in 1995/96 (Figure 4). Egypt, Morocco and Tunisia accounted for the majority (78%) of the total production of 4.4 million mt. SSA accounted for only 1.8% of global fertilizer production in 2005/06 (Table 3).

**Fertilizer trade: Africa and the rest of the world**

Trade of total nutrients (imports and exports) increased between 1995/96 and 2005/06 for Africa as a whole and for SSA. Total imports for Africa increased from 1.4 million mt of nutrients to 2.2 million mt of nutrients, an increase of 57%. The increase for SSA was 25%, from 0.8 million mt to 1 million mt. Total exports from Africa increased from 2.7 million mt to 3.1 million mt (an increase of 16%). The increase for SSA was 6%, from 78,000 mt to 82,500 mt. Table 4 shows net fertilizer trade for 2005/06. It can be seen that Africa as a whole is a net exporter; it exports more fertilizer than it imports. However, SSA is a net importer of fertilizers.

SSA’s almost exclusive reliance on imported fertilizer for its supply was not an inherent disadvantage before 2007 since there was ample supply of fertilizers in the global fertilizer market at relatively stable prices. However, the unprecedented increase in fertilizer prices between January 2007 and mid-2008 has renewed interest among policymakers, the private sector and farmers in exploring the viability of national and regional fertilizer production in Africa (Figure 5). The US Gulf price of diammonium phosphate (DAP), a popular basal fertilizer for the production of maize in many African countries, increased by approximately 365% from US$ 262/mt in January 2007 to US$ 1,218/mt by April 2008. Similarly, between January 2007 and August 2008, the price of urea in the Arab Gulf (urea is a popular top-dressing fertilizer for maize production in Africa) increased by 200%, from US$ 272/mt to US$ 815/mt.

These unprecedented fertilizer price increases were due to a number of factors, including oil prices at over US$ 100 per barrel that increased the demand for fertilizers to produce grain-based substitutes such as biofuel in Europe, the United States and Brazil; an increase in energy and freight prices; increased demand for grain-fed meat from the expanding middle-class societies of China, India and Brazil; and an increase in the price of natural gas, a major input for the production of ammonia for nitrogen fertilizers. However, farmers could not afford to purchase fertilizers at these astronomical prices, resulting in a drop in fertilizer quantity demand, leading to stock accumulation and drastic price declines (by mid-December 2008 the price of DAP had fallen to US$ 469/mt and the price of urea was lower than pre-2007 levels at US$ 247/mt). Although prices have since returned to pre-2007 levels due to the market correction, this experience clarified for African governments how vulnerable the continent is to global price volatility and has solidified interest in pursuing fertilizer production in Africa.

### Table 3. Fertilizer production in Africa and the world (‘000 tons NPK)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>World</td>
<td>148.3</td>
<td>142.7</td>
<td>144.4</td>
<td>164.9</td>
</tr>
<tr>
<td>East Asia</td>
<td>26.2</td>
<td>31.8</td>
<td>34.8</td>
<td>55.9</td>
</tr>
<tr>
<td>South Asia</td>
<td>11.2</td>
<td>14.3</td>
<td>18.2</td>
<td>19.1</td>
</tr>
<tr>
<td>South America</td>
<td>2.7</td>
<td>3.2</td>
<td>4.0</td>
<td>5.6</td>
</tr>
<tr>
<td>Africa Total</td>
<td>4.9</td>
<td>4.9</td>
<td>5.3</td>
<td>5.5</td>
</tr>
<tr>
<td>Africa % share in world</td>
<td>3.3</td>
<td>3.4</td>
<td>3.7</td>
<td>3.3</td>
</tr>
<tr>
<td>North Africa</td>
<td>3.5</td>
<td>3.8</td>
<td>4.5</td>
<td>5.1</td>
</tr>
<tr>
<td>Sub-Saharan Africa</td>
<td>0.5</td>
<td>0.3</td>
<td>0.2</td>
<td>0.1</td>
</tr>
<tr>
<td>South Africa</td>
<td>0.8</td>
<td>0.8</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>SSA % in Africa</td>
<td>10.2</td>
<td>6.1</td>
<td>3.8</td>
<td>1.8</td>
</tr>
</tbody>
</table>

Source: IFDC
Nevertheless, investment in fertilizer production is only economically viable if it is for production of 300,000 to 500,000 mt, which requires a capital investment of over US$ 500 million. Considering that only three countries in Sub-Saharan Africa consume more than 100,000 mt of nutrients, investing in large-scale production facilities in individual countries is not feasible. One option to pursue in the long run is to invest in fertilizer production in one country for local and regional consumption and export markets. However, for the short term, Africa will continue to import the majority of its fertilizer from the world market. Therefore, the retail price of fertilizer in Africa is determined by three factors: the world market price; exchange rates; and domestic marketing costs. Since Africa is a consumer in the global market, its response options with regard to reducing the price paid on the world market are limited. In this era of free trade and globalization, governments are also limited as to the extent by which they can manipulate exchange rates to mitigate the impact of price increases on farmers. Consequently, the key policy response has been increased use of subsidy programs in a number of countries. However, this response is expensive and in many cases unsustainable, and more importantly, it is typically implemented in a manner that eschews and undermines the private sector due to market distortions. A more viable alternative is to introduce policy measures that will reduce domestic marketing and transaction costs in the fertilizer value chain, and hence reduce the price paid by farmers by shifting the fertilizer supply curve to the right.

The remainder of this paper examines the fertilizer market in Africa, supply and demand side constraints to its performance, and makes recommendations for policy responses.
Conceptual framework: subsector analytical approach

Commodity subsector analysis provides an operational approach to analyzing market performance. A sector cuts across several industries, such as the food sector, which includes all the firms involved in the production and distribution of food. A subsector is defined as the entire range of business activities and services in the production and distribution of a specific commodity related vertically and horizontally by institutional arrangements, such as type of market exchange mechanisms (spot market, contracts, vertical integration), grades and standards, property rights and market regulations. The subsector approach also argues that the government must play a vital regulatory and facilitative role in system development (Shaffer, 1973, Holtzman, 1986). The horizontal dimension refers to firms within a particular industry. The vertical dimension refers to vertical coordination of product transformation and value-added by firm(s) at each stage of the subsector (from farmer to consumer) such as input distribution, production, assembly, storage, transport, processing, distributing, wholesaling and retailing. There are key structural components that facilitate the vertical progression of a commodity such as fertilizer from the producer to the final consumer. The key components of a subsector are the supply chains – the marketing functions, institutional environments and marketing participants. Supply chains map the flow of raw material to final products.¹ Various types of supply chains can exist in a subsector, each resulting in a different cost structure and final price. Supply chains can also be vertically integrated, whereby successive stages are absorbed under single ownership (for example, a fertilizer wholesaler can integrate forward into retailing, or an importer can forward integrate into wholesaling and retailing). Supply chains can also be of varying breadths (i.e., the number of competing firms at each stage). To move the commodity along the supply chain to the final consumer, firms carry out numerous marketing functions. These functions are the exchange functions of buying and selling; the physical distribution functions of transportation, storage and handling; and the facilitating functions of standardization, financing, risk-bearing and market information and research (Beierlein and Woolverton, 1991). Marketing costs are generated by the various marketing functions carried out to move the commodity to the final consumer, and in doing so they add value as well as cost to commodities. These marketing functions and institutional arrangements are performed within each supply chain within a specific market environment. The aggregation of these supply chains defines the subsector, and the market environment is the context within which the marketing functions, institutional arrangements and market participants operate. The market environment comprises the institutional, social and demographic, and physical environment factors. The institutional environment is composed of the formal and informal rules, information flows (prices, supplies, levels and patterns of distribution), and enforcement institutions. Many institutional agencies are public sector entities, such as the Port Authority, Bureau of Standards, and Ministries of Agriculture. The types of marketing functions that have to be performed are determined by the physical characteristics of the commodity. Socio-demographic and physical factors also determine marketing functions that have to be carried out and the performance of the market. Market participants are marketing and facilitating intermediaries who perform one or more marketing functions in the subsector and use various institutional arrangements to coordinate their activities. The main purpose of the marketing intermediaries is to market and distribute the commodity in the least-cost manner and sell it at a price that will maximize their profit.

The subsector approach is based on the adaptation of the industrial organization theory (Bain, 1968; Scherer, 1980). This theory posits that the structure (S) of an industry strongly influences the competitive conduct (C) of firms within that industry, which in turn strongly influences market performance (P) (Bain, 1968; Scherer, 1980). Hence, the conceptual framework for subsector analysis includes components of structure, conduct and performance.

Industry structure refers to the characteristics of market organization that influence the nature of competition and pricing within the market. Some key indicators of market structure are: market concentration, product characteristics, entry and exit conditions, capital requirements, economies of scale, and vertical integration. Subsector organization refers to: timing of marketing

¹The value chain is distinct from the supply chain, even though “value-chain” and “supply chain” tend to be used interchangeably in the literature and presentations. Analysis of supply chains focuses on production of the final output from the raw material making achieving productivity improvements the primary goal. The value-chain approach focuses on the consumer and the individual subsector, seeking to increase the value derived from the price paid by consumers for the various market actors that participate in converting raw materials to processed consumer products (Draft Framework Document for CAADP Pillar 2). For the purposes of this paper, the term “supply-chain” will be used to encompass both the supply-chain and the value-chain.
functions; number of stages; number of parallel supply chains; information systems; types of exchange; risk-sharing institutions and arrangements; the location and size of enterprises; seasonality; and production and consumption characteristics (Steffen, 1995). Market conduct refers to a firm’s policies towards its product market and in response to moves made by its rivals in that market, in order to enhance its market share. There are three major areas firms focus on in this regard. First, price-setting strategies whereby the price can be the market-clearing price as in a perfectly competitive market; the monopolistic price (whereby the equilibrium price is set above the competitive level); or the oligopolistic price which falls in between these polar extremes of perfect and monopolistic competition. Second, they consider non-price strategies (promotion, product and distribution strategies). And third, firms seek strategic advantage and attempt to deter entry. Subsector conduct includes efforts to shift risk and gain market share, as well as coordination activities, such as the type of exchange arrangements used, information communicated, quality specifications and efforts to influence inter-stage cooperation and/or conflict.

Industry performance refers to the outcome or economic results of the structure of the industry and from the group of firms pursuing their respective lines of conduct. Both the industrial organization approach and the subsector approach focus on the performance consequences of alternative forms of industrial organization. The most popular performance dimension is economic efficiency, which has two aspects – allocative efficiency and technical efficiency. Allocative efficiency refers to the capability of prices to allocate resources efficiently in accordance with consumer preferences. It refers to the best choice of input combination, that is, whether the increased value from the use of an input (the marginal value product or MVP) is equal to or greater than the additional cost associated with the use of that input (the marginal factor cost or MFC). Accordingly, the rule for allocative efficiency of the marketing process is that additional functions and services should be performed until the additional cost associated with the performance of the marketing functions equals the increased value from performing the marketing functions and services. Allocative efficiency of a subsector can be evaluated by analyzing trader profit margins, that is, what remains once the trader deducts the marketing costs generated by the marketing process, plus a competitive return on investment and entrepreneurship. With respect to the second dimension of economic efficiency, a firm is technically efficient if the production function yields the greatest output for any set of inputs. This performance dimension is concerned with the degree to which any output is produced in the least-cost way.

To increase the efficiency of the marketing process, it is possible to reduce the costs of performing a marketing function. This may involve eliminating marketing intermediaries, but marketing functions cannot be eliminated from the marketing process. Eliminating marketing intermediaries involves the transfer of marketing functions and costs to someone else. Therefore, two key issues concerning marketing functions are whether the necessary number of functions is being performed and whether these functions are being performed in the most efficient (least-cost) manner. In addition to the efficiency performance dimension, subsector performance dimensions are the dynamic performance dimensions of the marketing system. In other words, how effective is the system with respect to product suitability (quality, variety); system progressiveness (adoption of innovative handling and distribution methods such as re-bagging and various forms of vertical coordination); and equity of returns to system participants given distribution of investments, risk and responsibilities.

**Operationalizing the approach: analysis of African fertilizer markets**

Figure 5 illustrates the physical flow of fertilizer from the overseas supplier to the farm gate in the typical fertilizer market in Africa. In doing so it depicts the players in the African fertilizer market (structure), the functions performed by these main actors (conduct), and the costs and margins generated as these functions are carried out (performance). These functions are carried out within an enabling environment that is composed of public policies, the regulatory framework, laws and institutions, the physical geography and climate of the country, and the infrastructural set-up. The magnitude of the costs and margins generated by carrying out each function is influenced by the policy, regulatory and institutional environment as well as the basic market conditions (size of the market, infrastructure) and physical conditions (climate, soils, land formations, etc.).

This paper uses the modified industrial organization (I-O) approach to analyze the African fertilizer market. I-O theory...
recognizes that the basic conditions of a fertilizer market will influence structure and conduct, and hence performance. An important dimension of African fertilizer markets comes into play in this regard. I-O theory places heavy importance on structure of a market as an explanation for its performance – for example, if market performance is poor, the reason must be found in its monopolistic or oligopolistic structural characteristics. However, in Africa a particular basic condition of the fertilizer market adds an important explanatory dimension to market performance. Specifically, the poor state of the transportation infrastructure has a major impact on the performance of the fertilizer market. Therefore, in addition to the three characteristics identified by I-O theory, this paper will add “outreach” as a fourth market characteristic to analyze fertilizer markets in Africa.

The fertilizer market in Africa is made up of various types of supply chains with different numbers of stages and actors at each stage. Figure 6 illustrates the six main types of supply chains (SC) found in SSA.

SC1 represents the typical organization of fertilizer supply chains in Africa where markets have been liberalized. Importers procure fertilizer from overseas suppliers and sell it mainly to wholesalers/distributors but also directly to retailers/agro-dealers. The latter typically occurs in countries like Uganda.
where the wholesaler/distributor level does not exist or is insubstantial. Retailers/agro-dealers also sell fertilizers directly to small-scale farmers or sell it to stockists who then sell it to small-scale farmers. However, these supply chains are typically weak and undeveloped due to a number of supply- and demand-side constraints which will be elaborated upon later in this paper.

SC2 represents a more mature organization of fertilizer market with domestic production of fertilizers and distribution via well-developed wholesaler/distributor and retail networks. However, such systems only exist in North Africa and South Africa; there are few such systems in Sub-Saharan Africa.

SC3 is commonly found in the export cash crop sectors of SSA such as tea and sugar in Kenya, tobacco in Malawi, cotton in West Africa, and sugarcane in Mauritius. These companies either procure fertilizer directly from overseas suppliers or place orders with local importers for their contracted out-growers. They supply fertilizer on credit and deduct the cost of the inputs and other services at harvest time.

SC4 is found where NGOs implementing development projects also procure fertilizers for their farmers via local importers as part of their project objective of improving food security. The NGOs provide the fertilizers to their farmers directly for free, at subsidized prices or on credit. Alternatively, NGOs help their farmer groups set-up farmer service centers, which then purchase fertilizers from importers and sell it to members (at a discount) and to non-members.

SC5 occurs when government-owned enterprises procure fertilizers for their national fertilizer programs. They either procure it directly from overseas suppliers or via local importers using a tender system. These fertilizers are typically distributed via government parastatals or the ministry of agriculture extension service for free, at subsidized prices or on credit. The private sector is not involved in the distribution of fertilizers procured by the government.

Basic conditions – Small-scale farmers produce the majority of agricultural products in SSA, but they use little or no chemical or organic fertilizers to do so. More fertilizer is applied to staple foods than to export crops; 40% of the fertilizer consumed in SSA is used on maize, followed by other cereals (wheat, barley, teff, sorghum and millet). Fruits and vegetables and sugar cane account for 15% of fertilizer use, and rice, tobacco, cotton and traditional tubers (cassava, yams) account for 2-3% each (Morris et al., 2007). Average fertilizer use in SSA is 10 kg/ha, one-tenth of the world average (100 kg/ha). Consequently, national fertilizer markets are small, with the majority of countries in SSA consuming less than 10,000 mt of nutrients per annum. These markets are characterized by too many products relative to market size. For example, the West African cotton sector has a high level of fertilizer product differentiation among different countries, despite the fact that they have similar soil types. Similarly, Malawi has 20 fertilizer products in use. Many are compound fertilizers, typically NPKs with minor variations in content. These are low-analysis fertilizers, and the nutrients are more expensive than the same nutrients found in straight high-analysis fertilizers because it is more expensive to manufacture smaller amounts of specific types of fertilizers.

Fertilizer markets in Africa underwent liberalization to varying degrees beginning in the late 1980s/early 1990s, but in many countries the government is still involved in fertilizer importation and/or distribution to varying degrees. The majority of fertilizer consumed in Africa is in granular form. Therefore, either it is imported already bagged or it is imported in bulk and bagged at the port at a flat cost per bag using equipment owned by the port authority and/or private bagging companies. With regard to handling and storage, palletization is often not used in Africa; instead bags are carried manually or dragged, which can result in torn bags and spillage. Fertilizer is hydroscopic, so improper storage can result in caking and/or its chemical composition can be affected due to exposure to heat and humidity. Losses due to improper handling and storage can therefore be quite high. The seasonality of demand for fertilizers and the low purchasing power of smallholders, which usually results in small and frequent purchases, increase transportation, storage and transaction costs.

Structure – In the majority of cases, the African fertilizer market resembles an oligopoly, particularly at the importer level with a few (typically five) importers accounting for 90-95% of the importer market share. However, this is not necessarily indicative of market concentration because, given the financial, logistical and management barriers to market entry, the fertilizer market in Africa lends itself to an oligopolistic character:

- First, importation of fertilizer is a capital-intensive venture. For example, procurement of 25,000 mt of urea from the Arab Gulf at US$ 270/mt would require US$ 6.75 million to purchase at July 2009 prices (f.o.b.). Few African
businessmen can raise this kind of money at one time, and stiff collateral requirements and high interest rates make borrowing from local financial institutions impossible for many. Therefore, importers have to use a letter of credit, which typically has a grace period of 90 to 180 days. However, it is impossible to ship and sell such a large quantity in this time frame, so domestic interest rates, (25-30% in 2009) become a factor. Moreover, to obtain the credit facility, importers have to meet the collateral requirements (typically 100-150% of the loan amount), have a solid financial and business record, demonstrated business and accounting skills and international trading experience. Consequently, only a small number of importing firms – typically those with connections to the international banking industry and linkages to the international fertilizer manufacturing industry – can survive, which contributes to the oligopolistic market structure.

- Second, fertilizer is a bulk product, so only firms that have strong logistics management skills can survive.

- Third, the fertilizer industry has economies of scale in production and procurement, which again contribute to the oligopolistic market structure of the industry.

**Outreach** – Importation of fertilizer into Africa is location-specific, while in most countries its consumption is highly dispersed and located at a distance from the port. Therefore, a reliable and efficient transportation system is required to move fertilizer to farmers in Africa. However, the road network in Africa, particularly in rural areas, is sparse and those that do exist are poorly maintained. This limits the distance traders and public transporters are willing to travel to deliver fertilizer to the farm gate and increases transaction costs (in terms of time and money) because trucks have to travel slowly and therefore take longer. Poorly maintained roads result in high maintenance costs for trucks, which increases transport charges and further contributes to high transaction costs. As a result, there is poor availability of fertilizers in rural areas and high prices for fertilizers that do reach the farm gate.

**Conduct** – Market participants in the fertilizer supply chain in Africa use three main strategies to maximize the value they extract from the final price paid by the consumer: price-setting strategies; non-price strategies; and strategies to gain strategic advantage. The fertilizer market in Africa is typically very competitive at the wholesale and retail levels. In general, fertilizer wholesalers and retailers are “price takers” in the buying market; their suppliers quote the price and they accept or reject it in favor of another price. Mark-up pricing is commonly used to set the selling price at which these fertilizer traders set their selling prices to cover costs and make a normal profit (that is, zero economic profit) within the constraints set by market conditions. They operate on small profit margins and high turnover.

The degree of competition at the importer level is under dispute. Importers insist that despite the oligopolistic market structure, competition is fierce as importers compete for distribution channels. Typically, importers do not integrate forward due to the high overhead costs and risks involved. Studies on importer margins support this claim. However, studies have also revealed that in some countries, large importers may be able to exert their market power to set prices closer to monopolistic competition than perfect competition and obtain above-normal returns. For example, large importers in some countries publish and distribute a price list to their subsidiaries/agents and customers at the beginning of the trading season and maintain these prices throughout the season, regardless of market conditions, thus setting a price ceiling for other firms. In some markets there is a price leader (by virtue of its substantial market share and popularity of its fertilizer) that has the ability to influence market price up or down as a function of its larger volume.

With regard to non-price strategies, fertilizer firms have developed a variety of marketing strategies in an effort to differentiate their product(s) and themselves from their competitors and gain customers. One type of product differentiation employed in the fertilizer industry in Africa is branding by fertilizer importers, whereby importers typically use the name of their company as their brand name. Farmers are aware of the various brand names and prefer some brands to others; it is common for farmers to ask for a type of fertilizer by its brand name. However, with the exception of a few billboards, importers do not advertise. This is primarily because, given the small size of the fertilizer market in Africa, branding is a sufficient means of reaching consumers and the potential increase in sales revenue from advertising would be smaller than the associated cost.\(^6\)

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\(^6\)In contrast, larger markets with more variety of needs among their customers and therefore a larger number of market niches, have to advertise to win over customers.
With regard to seeking strategic advantage, it is common for some of the smaller importers/distributors to purchase fertilizer from the large-scale importer and/or combine their shipments with them to reduce purchasing and shipping costs. Wholesalers and retailers will also combine transport to reduce transportation costs, and typically offer technical advisory services to customers as well as delivery and price discounts when a minimum number of bags are purchased.

**Performance** – As the main actors in the fertilizer supply chain carry out their functions, they generate costs and also take remuneration for their services in the form of profit margins. Figure 7 illustrates fertilizer supply chains for urea in Thailand, Tanzania (a coastal country) and Mali (a landlocked country) in 2006. Figure 7 illustrates the costs that are incurred as the various functions are performed along the supply chain, and illustrates their percentage contribution to the retail price. The main cost components are the product cost (f.o.b. and bagging), taxes and levies, transportation, finance and total profit margins by traders. Comparing the value chains for the three countries provides some useful insight with respect to performance of the fertilizer market in Africa. It is evident that (in absolute terms) product costs are relatively similar in the three countries. They account for the largest component in the supply chain, representing 81% of the retail price in Thailand (US$ 229/mt), 65% of the retail price in Tanzania (US$ 251/mt) and 49% in Mali (US$ 252/mt). However, all other costs are much higher in Tanzania and Mali than in Thailand. Whereas these other costs account for 19% of the retail price in Thailand, they account for 34.5% of the retail price in Tanzania, and 53% in Mali. Some proportion of these higher costs in Africa are legitimately incurred while performing the various marketing functions; however, some proportion of these costs are incurred as a result of the constraints imposed by the policy, regulatory and institutional environment. Consequently, the retail price of urea in Tanzania is 50% higher than that in Thailand and in Mali it is 80% higher. In general, in-country costs increased the cost of fertilizer to the farmers in Africa by 60-100% compared with 20% in Thailand.

![Figure 7: Fertilizer cost build up: Thailand vs. Sub-Saharan Africa (2006)](image-url)
The other cost components that are responsible for the higher in-country costs in Tanzania and Mali are transport costs, total margins and finance costs. Taxes and levies are also a major factor in Mali. Total transport costs include ocean freight and port charges, inland transport and retail transport costs. These costs account for 22% (US$ 93/mt) in Tanzania and 32% (US$ 165/mt) in Mali compared with 11% (US$ 31/mt) in Thailand. As is to be expected, transport costs are higher in landlocked countries like Mali compared with coastal countries like Tanzania, which do not have to contend with inland transport costs. In general, transport costs are US$ 119/mt for coastal countries in Africa and US$ 136/mt for landlocked countries. The higher transport costs in Africa are due to a number of factors. First, higher ocean freights and port charges in coastal African countries (US$ 49/mt) compared with US$ 23/mt in Thailand in 2006 due to relatively smaller cargo sizes, difficulties of finding return cargo and port congestion due to poor infrastructure. For example, cargoes to Thailand are 44,000 mt compared with the majority of fertilizer trade in SSA which is in small consignments of 1,000-25,000 mt (bulk) and 5,000–10,000 mt (bagged). Second, port charges in coastal African countries (US$ 12/mt) are over 10 times higher than those in Thailand (US$ 1/mt). A contributing factor is the various “fees” charged by the port authority and customs agents at the ports and countries of destination, which are undocumented. These illegal payments (or bribes) can be quite substantial in the fertilizer supply chains in Africa. They include fees for activities such as holding discharge space at the port, bribes so importers can avoid paying demurrage fees and so truckers can avoid long delays at border points. Inland transport costs are a third significant component of total transport charges. They can account for 20-40% of the retail value of fertilizers in Africa. Poor road conditions, high maintenance and fuel costs, and illegal payments at border posts all contribute to increased transport costs.

Total margins are the third-largest component of fertilizer supply chains in Africa. Importer, wholesaler and retailer margins account for 3% of the retail price in Thailand compared with 6% in Tanzania and 8% in Mali. Finance costs are the fourth-largest component in the three fertilizer supply chains depicted in Figure 7. They account for 4% of the retail price in Tanzania and Mali, compared with 2% in Thailand. Finance costs are composed of the costs of obtaining letters of credit (LC), bank fees, and interest rates incurred by importers, distributors and retailers.

The reasons for the discrepancy are the cost of opening accounts and the cost of LC in Thailand is much lower than that in Africa; it is 0.25% in Thailand, which is which is one-tenth the rate charged in Africa. Moreover, interest rates in Thailand are 5% per annum for importers and 7% for wholesalers and retailers, compared with 25-30% per annum in Africa.

What accounts for the higher costs and margins in African countries than in Thailand? A key reason is poor market development in Africa. Thailand has lower margins and overhead costs due to a higher level of development of retail networks in terms of quantity and quality of market actors (there is one retailer per 5,000 farmers in Thailand), fierce competition at all levels of the supply chain and the high volumes of business conducted. These attributes are absent in Africa’s fertilizer markets due to a number of supply and demand constraints that are inflating the magnitude of these costs above what they would be in a competitive market. That is, there is a component of each cost that can be justified by the function performed (whereby Price = Marginal Cost). But in African fertilizer markets the final consumer price is not equal to the marginal cost but is above it (Price > Marginal Cost), because there are rents or additional costs. These rents emanate due to the policy, institutional and regulatory environments in which the fertilizer market operates. The next section will elaborate on the nature of these constraints and provides a description of the cost savings that could be derived if these constraints were reduced or eliminated. Quantification of these cost savings, while challenging and in some cases impossible, would provide a solid basis for policy recommendations aimed at reducing transaction costs and improving the performance of fertilizer supply chains in Africa. Policy responses that could be introduced to address these constraints are proposed later in this paper.
<table>
<thead>
<tr>
<th>Supply-side constraint</th>
<th>Cost component</th>
<th>Source of potential cost savings</th>
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<tbody>
<tr>
<td><strong>Function = Procurement</strong></td>
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<tr>
<td>Many countries have regulations that prescribe specific nutrient compositions or granule sizes of fertilizers that can be imported.</td>
<td>f.o.b. price</td>
<td>If these regulations were removed, importers could import fertilizers that are commonly found in international markets and still meet the agronomic needs of farmers. This is considerably cheaper than buying fertilizers that have been specially blended for the typically small fertilizer markets in Africa. This would also allow the introduction of innovations to reduce costs, such as bulk importation and blending.</td>
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<tr>
<td><strong>Function = Financing</strong></td>
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<tr>
<td>Commercial banks have liquidity but they regard lending to agriculture as high-risk. To minimize risk they charge high interest rates and impose strict collateral requirements. As a result:</td>
<td>Collateral requirement (100-150%); cost of credit (15-20%)</td>
<td>If risk-sharing mechanisms that mitigate the risk borne by financial institutions could be introduced, banks would be more willing to extend credit to importers and agro-dealers and at reduced interest rates and collateral requirements. a. The magnitude of finance charges in importer margins would be reduced. b. Agro-dealers would have access to credit so they would not incur the costs emanating from small consignment sizes, high frequency of purchases, low inventories resulting in lost sales and inability to achieve economies of scale in purchasing and transportation.</td>
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<tr>
<td><strong>Function = Production</strong></td>
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<tr>
<td>Examples of government policies that undermine existing local fertilizer production activities:</td>
<td>f.o.b. price</td>
<td>If policies were supportive of local production, local fertilizer manufacturers would operate near or at capacity to produce fertilizer for local and regional markets at competitive prices. a. some governments import fertilizers instead of ordering from local fertilizer producers; b. foreign exchange restrictions which make importing raw materials for fertilizer production difficult.</td>
</tr>
<tr>
<td><strong>Function = Port Charges and Handling</strong></td>
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<tr>
<td>Only port employees are allowed to unload ships, but ports are typically understaffed.</td>
<td>Handling costs and demurrage charges</td>
<td>If private companies were allowed to make their own arrangements for unloading, it would be accomplished more quickly. This would reduce handling costs and demurrage charges associated with the slow rate of discharge from ships.</td>
</tr>
<tr>
<td>Supply-side constraint</td>
<td>Cost component</td>
<td>Source of potential cost savings</td>
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<tr>
<td>Ports are underequipped (low number of shore handling cranes) and the off-loading equipment is not well maintained.</td>
<td>Handling costs and demurrage charges</td>
<td>If the port equipment was not insufficient and in poor condition, and private companies were allowed to operate at the port, ships would be unloaded faster. This would reduce handling costs and demurrage charges.</td>
</tr>
<tr>
<td>Insufficient number of bagging machines at the port and private companies are not allowed to operate.</td>
<td>Cost of bagging</td>
<td>If there were sufficient number of bagging machines at the port and private bagging companies were allowed to operate at the port, importers could import larger quantities in bulk and bag them at the port, which is cheaper than importing bagged fertilizers. This would reduce bagging costs and improve the quality of bagging.</td>
</tr>
<tr>
<td>Silt build-up at ports limits the size of ships that can be discharged.</td>
<td>f.o.b. price</td>
<td>Dredging of ports to permit entry of large ships carrying bulk cargo.</td>
</tr>
<tr>
<td>Inadequate warehousing facilities at the port (small sheds and/or low number).</td>
<td>Warehousing costs</td>
<td>If bulk storage capacity were adequate this would enable more efficient discharge from ships, thus reducing demurrage charges.</td>
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**Function = Inland transportation**

| Roads – the poor state of roads and numerous roadblocks cause significant time and fuel inefficiencies. | Transport costs | If roads were improved and maintained, transport charges would not be increased to account for the cost of frequent maintenance/repair of trucks due to high wear and tear and fuel inefficiencies. If rail had been improved, importers could use rail instead of roads, which would reduce transport costs substantially (rail transport is 30% cheaper on average than road transport). |
| Railway systems – inefficient, unreliable and undercapitalized. | |

**Function: Wholesaling/retailing to the farmer**

| Quantity: The number of agro-dealers and stockists is insufficient and they are concentrated in towns and district headquarters. Few are located in villages closer to the farmers. As a result farmers have difficulty accessing inputs. Quality: Business and technical skills of agro-dealers and stockists are inadequate (product knowledge, information about fertilizer recommendations, bookkeeping and marketing skills). | Wholesaler and retailer margins (overhead and administration) | If there was a developed agro-dealer network, agro-dealers would operate more efficiently; instead, lack of competition, ineffective management and poor service delivery result in higher costs. |
A key supply-side constraint is policy uncertainty and inconsistency. The majority of fertilizer markets in Africa have been liberalized and therefore the policy environment is generally conducive to the private sector. However, many African governments are unclear about their role in the fertilizer market; specifically, what they should do to support the fledgling private sector. At the same time, governments have little faith in the capability of the private sector. The result is two extremes in the governments’ approach to the fertilizer market. One extreme is a ‘hands-off’ approach whereby the government has withdrawn completely and left the private sector unsupported in terms of providing a facilitating policy, regulatory and institutional environment. The other extreme is “government intervention” – government involvement in the importation and/or distribution of fertilizer via the reinstatement of old parastatals, typically implemented in the form of an unclear and inconsistent subsidy policy that eschews the private sector.

Where the subsidy programs do not involve the private sector, the result is market distortions due to the sale of subsidized fertilizers by the government parastatals and the displacement of commercial sales, which discourages the private sector. Even where the private sector may be requested to import on behalf of the government, the information regarding quantities and timing is not always clear or provided in a timely manner, and the terms of participation can pose risks for private importers who decide to submit bids. For example, tenders can be unrealistic as they require physical stocks to be positioned in-country prior to tendering which poses a huge risk for importers as they have no guarantee their bid will be successful. Therefore, despite the liberalization of fertilizer markets in Africa, continued government involvement to varying degrees is creating an unequal playing field and disrupting the development of the burgeoning private sector.

Other supply-side constraints are fertilizer regulatory systems that are either nonexistent or ineffective where they do exist and weak market information systems. Many countries either do not have a legal and regulatory framework regarding quality, standards, measures, safety in use and business ethics vis-à-vis the importation, distribution, marketing and use of fertilizer products in the country. Where these frameworks do exist, the quality control systems are weak and implementation capacity is limited. Laboratory testing facilities are absent or outdated and the majority of countries have no inspectors or there are less than 10 inspectors for the whole country; hence inspection at the point of sale, where the risk of adulteration is highest, is limited.

Well-functioning markets require regular and accurate information about prices, quantities, stocks, deliveries and transaction costs. However, while in some countries information about output markets (commodity prices) is published in the daily newspaper, information collection and dissemination remain weak for input markets. The ministries of agriculture in many African countries do not have the human and/or financial resources to collect and disseminate market statistics and information. Consequently, importers, agro-dealers and farmers do not have sufficient, up-to-date information about market conditions to make intelligent decisions about where and when to buy and sell their fertilizers and other agricultural inputs.

**Demand-side constraints**

These consist of constrained fertilizer adoption due to the absence of stable output markets for increased production, weak or non-existent extension systems and outdated fertilizer recommendations.

**Constrained adoption of fertilizers due to absence of stable output markets for increased production** – The existence of reliable and stable output markets provide the incentive for farmers to use productivity enhancing technologies like fertilizers by providing reliable outlets for their marketable surpluses. However, while the markets for cash and export crops are well developed in SSA, the markets for food crops are poorly developed. Consequently, at harvest farmers are often faced with low prices, which reduce the incentive to use modern inputs.

**Outdated fertilizer recommendations** – Small-scale farmers in SSA lack knowledge about the correct and safe use of fertilizers. Very few farmers use basal fertilizers, some use basal (NPK) fertilizers for top-dressing, or they may use a mixture of both, due to knowledge and economic constraints. Moreover, even where farmers attempt to use fertilizers correctly their efforts are hampered by outdated fertilizer recommendations. Consequently, they use fertilizer grades and quantities that are not suitable for their soils and/or crop mix. This continuous cultivation without proper and adequate use of fertilizers has resulted in severe soil infertility and degradation problems in SSA. Consequently, crop yields and profitability are much lower than what is required to achieve food security and increased incomes.
product standards and enforce truth-in-labeling. These initiatives should be backstopped by improving the capacity for physical spot inspections at the point of sale. The ensuing rules and regulations should be harmonized with those of neighboring states to promote cross-border trade.

Promote fertilizer production – A number of factors have contributed to the increase in global fertilizer prices (fluctuating oil prices, increased demand for grain to produce biofuels, increased demand for grain-fed meat by newly affluent middle classes in emerging economies, etc.). Consequently, fertilizer production in Africa has become more financially and economically feasible. However, it takes four to five years to get a new urea plant built and producing, so adding new nitrogen manufacturing capacity must be a long-term solution. In the short term, a more viable approach is to import straight high-analysis fertilizers in bulk and utilize the nutrients to blend fertilizers for African markets. Once market size increases sufficiently to justify investing in fertilizer production, the approach would be to improve utilization of existing capacity and consider reinvestment to improve technology before establishing greenfield plants.

Transportation and logistics – Transport costs comprise the largest cost component in the fertilizer supply chain after the price of the fertilizer, and logistics are critical for timely delivery of the right types of fertilizer in the right places. There is a lot of scope for reducing the cost of transporting fertilizers by upgrading road, rail and port facilities but by necessity this is a long-term solution because it is capital-intensive. However, there are some measures that can be undertaken within a relatively short period of time to reduce the costs and improve the performance of transport and logistics activities in the fertilizer supply chain. First, governments should liberalize port activities to allow private-sector participation. This could result in an immediate increase in the availability of port handling equipment (number of bagging machines and shore-based handling cranes) at no cost to the government. The immediate benefits would be improved services and reduced port costs for importers. Second, establish bulk fertilizer holding warehouses where large fertilizer manufacturers would place fertilizer in the warehouse and small consignments of 100 mt or more could be purchased by small importers when needed at globally competitive prices. Third, with respect to inland transportation, governments should ensure that policies allowing the free
movement of fertilizers across borders are being implemented. Once funds are available, the priority should be to improve port facilities to reduce port congestion, improve port capacity and improve the road and rail infrastructure.

**Introduce financial mechanisms to share risk among stakeholders** – There is a need to introduce risk-sharing mechanisms to link commercial banks with importers and agro-dealers in a manner that will spread the risk among banks, fertilizer market actors, and donors. Specifically, governments and donors could create loan guarantee funds that will facilitate local importers to procure fertilizers on international markets at more favorable terms and to finance stocks for agro-dealers.

**Human capital development** – The quantity and quality of human capital all along the fertilizer supply chain needs to be improved. The number of agro-dealers needs to be dramatically increased and coverage improved so that farmers have access to fertilizers at affordable prices and in a timely manner, and farmers in the rural interior don’t have to travel more than 10 km to buy a bag of fertilizer. Similarly, the marketing and technical skills of importers, agro-dealers and stockists need to be improved and linkages between them established and strengthened. Importers need better linkages with market actors upstream and downstream to improve service delivery, and develop business linkages with regional counterparts through study tours to expand market share and better serve African farmers. Agro-dealers and stockists require training in business management and product knowledge which they can impart to farmers. Farmers require intensive and regular training in the correct and safe use of fertilizers, the economics of fertilizer use and marketing options for the different crops they produce.

**Market information** – Ministries of agriculture need to establish and operate market information systems to provide information to importers, agro-dealers, farmers and policymakers about market conditions. This flow of information should be regular and timely, and the content should be accurate. In this way every market participant can have access to reliable information about prices, stocks and deliveries in various segments of national, regional and global markets, and use this information to make the right decisions.

**Demand-side policy recommendations**

**Development of crop output markets** – Measures should be implemented to improve the prices received by farmers and dramatically increase output market demand. Output market demand can be increased by scaling-up and replicating output markets on different fronts – out-grower schemes, periurban agriculture, niche markets and non-traditional exports. The prices received by farmers can be improved by promoting the development of producer associations, dissemination of market information, introduction and enforcement of grade and standards for quality produce, improved storage and agro-processing facilities and warehouse collateral to facilitate the purchase of agricultural produce at harvest time.

**Technology transfer interventions** – There is a need to educate farmers about the proper use of fertilizers and management practices. This is best done by a revival of the extension systems of the ministries of agriculture that are designed to reach the widely dispersed farming community in Africa. The government extension system can be complemented by technical advisory services provided by trained agro-dealers, particularly for those farmers who are located within 10-30 km of the main district capitals and towns where agro-dealers tend to be concentrated. Farmers can be educated about correct fertilizer use and improved agronomic practices through fertilizer trials, demonstrations and field days. One-day training programs for farmers, agro-dealers and extension workers should also be organized. In addition, laboratories and facilities should be provided to enable soil analysis and testing to update the fertilizer recommendations and make them more appropriate to the different agroecological zones and input and output market realities faced by farmers.

**Summary and conclusions**

This paper has proposed strategic interventions by the public and private sectors that will achieve efficiency gains in the fertilizer supply chain by reducing costs and margins and eliminating bottlenecks, thus making fertilizer marketing more efficient (reduce the farm-gate price of fertilizers) and increasing the viability of its use. It has also proposed strategic interventions on the demand side to help create demand in ways that are commercially sustainable.
The paper has three key conclusions. First, structure and conduct are not the main characteristics that explain performance in the African fertilizer market. A basic condition of the fertilizer market in Africa, namely the poor transportation infrastructure, has a defining impact on market behavior and hence on performance. Specifically, the poor transportation infrastructure creates a disincentive for importers and agro-dealers to travel to the rural interior where fertilizer is needed most. The result is poor availability of fertilizers close to the farm gate and high farm-gate prices of fertilizers that do reach farmers due to high transport costs. The importance of this cannot be overemphasized, given that transport costs comprise, on average 30-50% of the farm-gate price of fertilizers in Africa.

Second, research on the intangible costs incurred as fertilizer moves from the port to the farm gate is required to reduce the price paid by African farmers for fertilizers. The price paid for fertilizers in Africa is higher than anywhere else in the world. Although global fertilizer prices have returned to pre-2007 levels, the factors that contributed to the increase in fertilizer prices, particularly the high oil and energy prices, are still very much in effect and are expected to become permanent features of the global agricultural landscape. Hence, it is unlikely that world market price will decrease in the near future. Therefore, the price of fertilizer in Africa can only be reduced through policy and market development efforts aimed at improving the efficiency and effectiveness of the domestic fertilizer market. Transport costs comprise the second-largest component of the farm-gate price of fertilizer after the purchase price, but the investments required to comprehensively address this bottleneck are huge, and it is a long-term intervention which is further complicated by the fact that transport cuts across many sectors of the economy. The remaining cost components account for approximately 20-30% of the farm-gate price of fertilizers. These costs are made up of tangible and intangible costs that are incurred as fertilizer moves from the port to the farm gate. The tangible costs are legitimately incurred as market intermediaries perform the various marketing functions involved. However, some proportion of these costs (the intangibles) is incurred as a result of policy, regulatory and/or institutional constraints. This paper has provided descriptions of the cost savings that could be derived if these constraints were reduced or eliminated. Quantification of these cost savings – while challenging and in some cases impossible – would provide a solid basis for policy recommendations aimed at reducing transaction costs and improving the performance of fertilizer supply chains in Africa. Therefore, research is required, first to quantify these costs and then to design interventions to effect relatively small cost-savings that combined can result in substantial reductions in the price of fertilizer.

Third, there is a need to reorient fertilizer subsidy programs, which are increasingly popular among African governments, to provide purchasing power support to resource-poor farmers. This will enable the governments to achieve the twin objectives of market development and improved food security by supporting fertilizer market development in the private sector while ensuring that resource-poor farmers can participate in the fertilizer market.

References


Abstract
Fertilizer use will have to increase in Africa if the region is to meet its agricultural growth targets, poverty reduction goals, and environmental sustainability objectives. Policies and programs are needed to encourage fertilizer use in ways that are technically efficient, economically rational, and market friendly. This paper seeks to contribute to ongoing efforts to build sustainable private sector-led fertilizer markets in Africa by highlighting lessons learned from past and present fertilizer promotion initiatives. Armed with these lessons, policy makers can avoid repeating mistakes made in the past, and they may be able to replicate successful features of ongoing fertilizer promotion initiatives. The paper discusses factors explaining low fertilizer use in Africa; reviews past experience promoting fertilizer use in Africa; briefly describes several multi-country initiatives to promote fertilizer; examines in some detail efforts being made to increase fertilizer use in Malawi (whose fertilizer program has received considerable coverage in the international media) and Rwanda (whose recent foray into fertilizer markets represents an experiment in market development); and presents a set of guiding principles to help in the design of future fertilizer promotion initiatives. An important conclusion is that since it is not always known what interventions will work in a particular setting, there is merit in continuing to experiment, as long as care is taken to document the results and learn methodically from experience.

Introduction
Agriculture’s central role in supporting broad-based growth has been conclusively demonstrated in many parts of the world, especially in Asia during the Green Revolution. Agriculture is the backbone of the rural economy in most African countries and has the potential to play a role in Africa similar to the one that it played in Asia, but agricultural growth in Africa has generally been disappointing. Over the past 20 years, in most African countries agricultural GDP per capita has risen very little, if at all, and in some countries it has actually fallen. For the region as a whole, what was once a downward trend in food production per capita has stabilized since 1990, but only a handful of countries have experienced significant gains (Byerlee, Diao and Jackson, 2005).

Low fertilizer use is one of the main factors explaining lagging agricultural productivity in Africa. In 2006/07, the most recent year for which data are available, the average intensity of fertilizer use in Africa was only 9 kg/ha of cultivated land, much lower than in other developing regions (IFDC). Even when countries and crops in similar agro-ecological zones are compared, the rate of fertilizer use is much lower in Africa than in other developing regions, and crop yields are correspondingly lower.

The striking contrast between the limited use of fertilizer in Africa and the much more extensive use of fertilizer in other developing regions has stimulated considerable discussion about the role of fertilizer in the agricultural development process, as well as debate about what types of policies and programs are needed to realize the potential benefits of fertilizer in African agriculture. In every region of the world, the intensification of crop-based agriculture has been associated with a sharp increase in the use of chemical fertilizer. Given the generally low levels of fertilizer use in Africa, there can be little doubt that fertilizer use will have to increase if the region is to meet its agricultural growth targets, poverty reduction goals, and environmental sustainability objectives. For this reason, policies and programs are needed to encourage fertilizer use in ways that are technically efficient, economically rational, and market friendly.

Over the years, many attempts have been made to promote fertilizer use in Africa, but with little success. Recently, the advent of the global food price crisis spurred renewed interest in fertilizer promotion as a way to boost food production, reduce food imports, and safeguard food security at the household level. Beginning in 2008, following sharp increases in international food prices, governments in many developing countries implemented emergency food production programs that included support to fertilizer promotion activities. Many of these programs had...
dual objectives: (i) in the short run, increase food production to counter effects of high food prices, and (ii) over the longer term, increase agricultural productivity to raise incomes and reduce poverty.

This paper seeks to contribute to ongoing efforts to build sustainable fertilizer markets in Africa by highlighting lessons learned from past and present fertilizer promotion initiatives. Armed with these lessons, policy makers can avoid repeating mistakes made in the past, and they may be able to replicate successful features of ongoing fertilizer promotion initiatives. Counting this introduction, the paper includes five sections. The second section discusses factors explaining low fertilizer use in Africa. The third reviews past experience promoting fertilizer use throughout the region. The fourth section briefly describes several multi-country initiatives to promote fertilizer and examines in some detail efforts being made to increase fertilizer use in Malawi (whose fertilizer program had received considerable coverage in the international media) and Rwanda (whose recent foray into fertilizer markets represents an experiment in market development). The last section summarizes emerging lessons and draws conclusions designed to help guide future fertilizer promotion initiatives.

Reasons for low fertilizer use in Africa

Low use of fertilizer in Africa is commonly blamed on market failures, especially information failure in product and credit markets. But this explanation requires some unpacking. When demand for fertilizer is weak and supply of fertilizer is constrained, it is hardly surprising that fertilizer use remains low. The market clears, but since the financial prices prevailing in the market reflect unnecessarily high transactions costs, the quantities of fertilizer bought and sold are lower than they would be if constraints could be removed. Low use of fertilizer therefore reflects markets that are clearing properly, but because the financial prices observed in the market contain distortions, the quantities being transacted are (for downstream markets) economically and socially sub-optimal. In this context, policy makers need to concentrate on identifying and removing the underlying constraints and/or correcting for the underlying market failures that are leading to weak demand for fertilizer and constrained supply.

Many initiatives have been launched in Africa to remove fertilizer market distortions and unleash the power of the private sector to procure fertilizer and deliver it to farmers. In a small number of cases, liberalization of fertilizer markets has had positive impacts, for example in Kenya, where fertilizer availability and use increased markedly following the introduction of market reforms in the late 1980s (see Jayne et al., 2003) Yet Kenya’s experience is atypical, and use of fertilizer continues to grow very slowly in most places. Why is this?

Factors constraining fertilizer demand

Evidence reviewed in Morris et al. (2007) suggests that demand for fertilizer is often weak in Africa because incentives to use it are undermined by the low level and high variability of crop yields on the one hand, and the high level of fertilizer prices relative to crop prices on the other. The demand-depressing effects of unfavorable price incentives are aggravated by many other factors, including the general lack of market information about the availability and cost of fertilizer, the inability of many farmers to raise the resources needed to purchase fertilizer, the high opportunity cost of capital (which if available often can be invested in other activities the returns to which are higher and/or more assured), and the lack of knowledge on the part of many farmers about how to use fertilizer efficiently. Because of these factors, fertilizer use is often unprofitable in Africa at current prices, particularly in marginal environments of low production potential, in remote areas poorly served by roads, and when the crops being grown are low-value food crops.

Factors constraining fertilizer supply

These constraints on the demand side are mirrored on the supply side by factors that reduce the timely availability of affordable fertilizer in the market. In many African countries, private investment in fertilizer distribution is discouraged by an unfavorable business climate characterized by excessive regulations, an abundance of taxes and fees, and high levels of rent seeking. As a result, fertilizer marketing is left mainly in the hands of inefficient public agencies. More fundamentally – and regardless of whether it is being done by public agencies or private firms – fertilizer distribution is unprofitable in many parts of Africa because of the weak and dispersed nature of demand, the small market size, high transportation costs stemming from inadequate road and rail infrastructure, and the limited availability and high cost of financing.
Slow emergence of the private fertilizer industry
Given the generally weak demand for fertilizer and the many constraints on supply, it is not surprising that few African countries have vibrant and competitive fertilizer industries. Without vibrant and competitive industries, fertilizer is rarely available when it is needed, where it is needed, and in the formulation that is needed. Even when farmers understand the benefits of fertilizer, know how to use it, and have the resources to purchase it, they may not be able to find adequate supplies in the market.

Factors that have hindered the emergence of a vibrant private fertilizer industry in Africa include the following:

- **Unfavorable business climate**: Private firms have been reluctant to invest in fertilizer marketing in Africa because they believe they cannot earn an attractive return on their investment. The bottom ranks of international business competitiveness tables are heavily populated with the names of African countries, which tend to score poorly in business investment climate surveys relative to countries from other regions. Common problems cited by firms trying to do business in Africa include poorly defined rules of the game, weak regulatory enforcement, a proliferation of taxes and fees, cumbersome bureaucratic procedures, a lack of security, and widespread incidence of corruption.

- **Uncertain policy environment**: Too many policy makers in Africa still think that the private sector cannot be relied upon to supply fertilizer and other inputs in a cost-effective manner. They believe that the public sector should carry out these activities. Unfortunately, attempts to improve the reliability of fertilizer distribution through public interventions often have the opposite effect, as government policies and programs show little consistency and frequently change in the face of shifting political winds. Arbitrary and often unpredictable government interventions in fertilizer markets produce an adverse impact at the micro-level (by undermining incentives for private fertilizer dealers at the wholesale and retail levels) as well as at the macro level (by complicating planning for the agencies and firms that import fertilizer).

- **Weak institutional and regulatory systems**: In a marketing system led by the private sector, one of the critical roles for government is to protect the interests of consumers and the general public by formulating and enforcing a legal and regulatory framework with respect to quality, standards and measures, safety in using and disposing of inputs, and business ethics. Even in African countries where fertilizer laws exist, their enforcement is generally inadequate. For example, in 2000 Nigeria experienced a serious problem with adulterated and mislabeled fertilizer products, yet regulations proved ineffective in addressing the problem (IFDC, IITA and WARDA, 2001).

- **Weak market information systems**: Many countries lack effective market information systems to support the development of well-functioning input markets. Importers and wholesalers often have limited information about where fertilizer is available in regional and global fertilizer markets, in what formulations, and at what prices. Similarly, dealers and farmers often do not know where fertilizer is available within the country, in what formulations, and at what prices.

Past experience promoting fertilizer in Africa
Efforts to promote fertilizer have had a checkered history in Africa (for reviews, see Kherallah et al., 2002; Crawford, Jayne and Kelly, 2006; and Morris et al., 2007).

Post-colonial period (1960s to mid-1980s)
Prior to the mid-1980s, most of the fertilizer promotion schemes implemented in Africa featured one or more of the following characteristics:

- **State-dominated fertilizer supply**: Fertilizer imports and distribution were often carried out by state-owned enterprises, which usually had to follow bureaucratic procurements procedures that hindered flexibility. Thirty of thirty-nine countries surveyed by FAO in the mid-1980s followed this approach (FAO, 1986).

- **Price controls**: Prices of fertilizer were usually set by government fiat. Prices were often made pan-territorial and pan-seasonal, ostensibly so that all regions and all farmers would be treated equally.

- **Price subsidies**: Subsidies were frequently introduced to make fertilizer more affordable for farmers. Subsidies ranged from 10% to 80% of the full procurement cost. Overvalued exchange rates often provided an additional indirect subsidy on imported fertilizer.
• **Subsidized credit:** State and parastatal input suppliers and government-owned banks often provided credit to farmers for financing fertilizer purchases. Interest rates were usually set below market rates and in some cases were negative in real terms.

• **Fertilizer aid:** Development organizations often provided fertilizer as aid-in-kind. Most of this fertilizer was sold to farmers at below-market prices or distributed free, and the type of fertilizer supplied sometimes had little relevance to local needs.

In some cases and for brief periods, the early programs to promote fertilizer succeeded in increasing fertilizer use and boosting food production. Yet in nearly all cases, the gains were not sustainable. Not only did the schemes impose high and unsustainable fiscal burdens on government treasuries, they also failed to boost agricultural productivity because of chronic problems with late or insufficient delivery of fertilizer. The fertilizer that did make its way to farmers often ended up being captured by wealthy farmers who least needed assistance, rather than reaching the smallholders who were supposed to benefit.

**Structural adjustment period (mid-1980s to 2000)**

During the 1980s and 1990s, when fertilizer sectors in many African countries were privatized and liberalized, many fertilizer promotion schemes also underwent changes. Announced reforms often included removal of price controls, elimination of subsidies, and withdrawal from the market of public agencies and parastatals. The degree to which these reforms were actually implemented varied considerably. In some countries, fertilizer promotion programs continued, albeit with modifications, as when governments attempted to reduce fiscal outlays by targeting fertilizer subsidies at poorer farmers (as in Zambia, Nigeria, and Zimbabwe during the 1990s). In other countries, parastatals were shut down, and subsidies were eliminated. These reforms succeeded in reducing the costs of fertilizer programs, but the gains came at a price. Following the withdrawal of government agencies, private operators did not step in to fill the gap as had been expected. As a result, fertilizer consumption decreased in many African countries, sometimes dramatically.

**Mixed approaches (post-2000)**

By the late 1990s, stagnating yields, declining soil fertility, and lingering food security problems had revived interest in promoting fertilizer in many African countries. Partly in response to these calls, pilot schemes were launched in several countries that featured the distribution of fertilizer without charge or at heavily subsidized prices. At the same time, perhaps in recognition of the fact that low fertilizer use is caused by many factors, efforts to promote fertilizer became increasingly eclectic and diverse. Different entry points were targeted, including:

• **Technology generation:** Recognizing that generalized fertilizer recommendations were not being adopted by many farmers, especially small-scale farmers, researchers established networks to conduct applied research designed to identify location-specific combinations of soil fertility management practices that could be adopted by farmers with different resource bases and varying risk preferences (e.g., the SoilFertNet network in southern Africa).

• **Technology transfer:** Recognizing that many African farmers lacked the crop and land management skills needed to use fertilizer efficiently, NGOs and some government extension services organized large demonstration programs to show the benefits that could be realized from appropriate use of fertilizer and complementary inputs (e.g., Sasakawa Global 2000 programs in 10 countries).

• **Input market development:** Recognizing that established small- and medium-sized rural traders lacked experience in marketing inputs, development organizations began funding NGOs to provide technical product and management training for retailers willing to stock inputs (e.g., The Rockefeller Foundation supported programs in eastern and southern Africa).

• **Output market development:** Recognizing that farmers are more likely to borrow money to invest in fertilizer and other inputs when output markets are secure, governments and development organizations renewed efforts to interlink markets for production credit, inputs, and outputs (e.g., cotton parastatals in West Africa).

While these initiatives varied in terms of strategy and tactics, each had its own advantages and disadvantages. A consistent theme was the effort made to scale back the role played by public agencies and parastatals in sourcing fertilizer and distributing it to farmers. In contrast to traditional models that had typically featured centralized state control of fertilizer distribution activities, most of the new initiatives were based on schemes in which leading roles were assigned to private firms,
NGOs, farmers’ organizations, or industry trade groups. Another feature of the new initiatives was their reduced scale, which improved operational flexibility but decreased overall coverage. This sometimes had the effect of leaving farmers in low-potential and physically remote zones without an alternative to the disbanded government input distribution programs.

Today, the situation is little changed. Efforts continue to increase the role of private operators in fertilizer marketing, but with few exceptions the response from the private sector has been muted. Macroeconomic instability and high interest rates, lack of marketing skills and finance, and inadequate regulatory systems and market transparency continue to limit the active involvement of the private sector in the input distribution business in many African countries. Years of discrimination and neglect have left the private sector underdeveloped and input markets fragmented. The slow response from the private sector has even led to a reversal of market liberalization policies in many countries, along with the re-introduction of fertilizer subsidies in some instances.

Overview of ongoing initiatives

Undeterred by the legacy of failure, governments, development organizations, and funding agencies have continued to promote fertilizer in Africa. This section briefly reviews several multi-country initiatives and then discusses in some detail the experiences of Malawi and Rwanda, two countries in which innovative approaches to promoting fertilizer have been piloted, with varying degrees of success.

Multi-country initiatives

Sasakawa Global 2000 (SG 2000): A joint program of the Sasakawa Africa Association (SAA) and the Global 2000 program of the Carter Center, SG 2000 was launched during the mid-1980s with the goal of doubling or tripling cereal crop yields in Africa. This ambitious objective was to be achieved by transferring improved agricultural technology to small-scale farmers. The first two SG 2000 country programs were launched in 1986 in Ghana and Sudan; additional programs were subsequently initiated in eight additional countries (Nigeria, Burkina Faso, Mali, Guinea, Ethiopia, Tanzania, Malawi and Mozambique). Beginning in 2004, operations in some of these countries were phased out so the program could concentrate on a small number of focus countries.

The approach used by SG 2000 involved three main components: (i) crop production demonstration plots, (ii) post-harvest technology demonstrations, and (iii) input dealer development activities (Howard et al., 1999). The first and third of these involved fertilizer. In supporting the establishment of large numbers of crop production demonstration plots, SG 2000 made sure that participating farmers had access to the recommended quantities of fertilizer, with the objective of demonstrating the effectiveness of fertilizer in raising yields while at the same time building future demand for fertilizer among farmers. To ensure that adequate supplies of fertilizer would be available in the market to satisfy the increased demand, SG 2000 worked with local traders (mainly village-level retailers but also some regional wholesalers) to help them become familiar with fertilizer procurement and distribution procedures.

While the impacts of SG 2000 varied considerably across countries and between components, it is fair to say that the program’s efforts to promote fertilizer use had limited lasting impact. The crop production demonstration plots were frequently effective in demonstrating that proper application of fertilizer could have a significant impact on yields, and the input dealer development activities usually helped ensure the procurement and distribution of the fertilizer needed for the demonstration plots, but in retrospect it is clear that the SG 2000-supported interventions failed to establish the basis for a viable private sector-led commercial fertilizer industry. Anecdotal evidence suggests that in most of the areas where SG 2000 was once active and has since withdrawn, fertilizer use has dropped significantly, and even though many farmers who participated in the SG 2000 programs remain convinced of the benefits, they lack the means to purchase fertilizer, have difficulty finding it in the market, or both.

The Millennium Villages Project (MVP): This initiative grew out of the UN Millennium Project and is led by science, policy and planning teams from The Earth Institute of Columbia University, Millennium Promise, and the United Nations Development Programme (for background, see UN Millennium Project, 2005). The objective of MVP is to help rural African communities lift themselves out of poverty by putting science and technology to work to tackle interrelated problems in the areas of food and nutrition, health, and education, among others. The approach used by MVP is being pioneered in about one dozen villages in
10 African countries. Once the effectiveness of the approach has been demonstrated, the sponsors intend to scale up interventions to the regional and eventually national levels.

Improving agricultural productivity has been a major theme in many MVP sites. To this end, MVP has introduced improved seed, fertilizer, crop chemicals and improved crop management practices. Since many households in the MVP sites lack the resources to pay for improved inputs, MVP has often elected to distribute them at no cost. Uptake of the inputs has led to marked production increases in at least some of the MVP villages and improvements in food security for many participating households.

Since MVP is still a work in progress, it is too early to assess its performance. To date no rigorous impact evaluation work has been done, so claims regarding the alleged successes and failures of the approach are not subject to independent empirical verification. However questions have been raised about the considerable administrative costs of the approach, which it is charged are likely to prevent scaling up to a significant level (Buse et al., 2008). With regard to the agricultural activities in particular, critics of the MVP approach have pointed out the high fiscal costs associated with free distribution of inputs, especially fertilizer. MVP proponents have countered with the argument that the fiscal cost of subsidizing inputs is lower than the cost of importing food for distribution to destitute households (J. Sachs, pers. comm.).

Regardless of whether or not the fertilizer being distributed through MVP programs is being used cost-effectively, it seems unlikely that the demand for fertilizer being created through MVP schemes will stimulate the emergence of a viable commercial fertilizer industry. Procurement of MVP fertilizer is handled largely by program staff, who arrange for transportation to the villages and local storage prior to distribution to the recipient households. The lack of concern to develop sustainable private sector-led fertilizer industry presumably reflects the desire of MVP leadership to produce "quick wins." It may also reflect the belief that use of fertilizer by poor rural households to produce low-value food crops is unlikely to be financially profitable, justifying continuing participation by the public sector in fertilizer distribution activities.

**The Alliance for a Green Revolution in Africa (AGRA):**

Established in 2006 by The Rockefeller Foundation and the Bill & Melinda Gates Foundation, AGRA is currently working with African governments, other donors, non-governmental organizations, the private sector, and farmers to improve the productivity and incomes of resource-poor farmers in Africa. AGRA is or expects to be working in a number of areas, including:

(i) developing better and more appropriate seeds; (ii) fortifying depleted soils through responsible use of soil nutrients and improved management practices; (iii) increasing incomes through improved access to agricultural input and output markets; (iv) improving access to water and raising water-use efficiency; (v) encouraging government policies that support small-scale farmers; (vi) developing local networks of agricultural education; and (vii) understanding and sharing African farmer knowledge.

The AGRA Soil Health Program is investing in four main areas:

- Improving knowledge, application, and adoption of integrated soil fertility management practices;
- Improving economic access to fertilizer for poor farmers;
- Increasing physical access to fertilizer for poor farmers; and
- Developing policy and incentives to promote adoption of improved soil fertility management practices.

Implementation of the AGRA Soil Health Program is only just getting underway, so it remains to be seen what activities will be supported. However given the strong links between AGRA and The Rockefeller Foundation, it seems likely that efforts will be made to broaden and deepen the successful work financed by The Rockefeller Foundation in eastern and southern Africa during the 1980s and 1990s to build fertilizer distribution networks in rural areas. Working with local organizations in rural Kenya, Malawi, and Uganda, The Rockefeller Foundation supported a number of pilots:

- Training rural retailers to develop their technical, product management, and business management skills;
- Linking certified agro-dealers to agricultural input supply firms using partial credit guarantees that covered 50% of the risk of default;
- Repackaging seed and fertilizer into small packs to increase affordability for farmers; and
• Organizing agro-dealers into “purchasing groups” to facilitate bulk purchasing of fertilizer from suppliers.

Although implemented on a limited scale, these efforts to strengthen rural fertilizer distribution networks achieved promising results. In Malawi, a survey of rural markets showed that the majority of farmers in areas where the program was active had started to buy their inputs from local agro-dealers, not from the government-owned Agricultural Development and Marketing Agency (ADMARC) or from large commercial distributors in urban areas. As the number of agro-dealers expanded, the distances traveled by smallholder farmers in search of inputs were reduced. The range, volume, quality and prices of agricultural inputs supplied into rural areas also improved significantly. Meanwhile, the default rate on the credit guarantees was less than 1% during the time when the program was active. The low default rate was attributed to the high quality of the technical and business management training received by the agro-dealers, and to their use of collective action to ensure repayment. Finally, as a result of increased involvement in seed and fertilizer sales, agro-dealers became important extension nodes, and several seed, fertilizer, and agro-chemical companies now use the agro-dealers to conduct demonstrations of new technologies.

Country case studies

**Malawi** - Agriculture accounts for 38% of Malawi’s GDP, 85% of employment and 85% of foreign exchange earnings. Eighty-eight percent of the country’s population lives in the rural areas. Tobacco is the dominant cash crop, with smaller contributions from sugar, cotton, tea and coffee. Over 95% of all smallholders grow maize and depend on this crop for food security. The majority of Malawi’s farmers are extremely poor. Fifty-two percent live below the poverty line and 22% are classified as ultra-poor. Forty-three percent of children under five years of age are stunted (Republic of Malawi, 2006). Forty-six percent of smallholders own less than one hectare. Most of these households fail to produce enough grain to meet their annual requirements. Many are forced to sell family labor during the planting season in order to earn cash necessary to purchase food and agricultural inputs. Most smallholders use fertilizer, though very few purchase fertilizer at commercial prices. The majority relies upon input subsidies to help offset high retail costs. An estimated 55% of smallholders plant hybrid maize. (Republic of Malawi, 2006).

**Fertilizer subsidies and food security:** Malawi has recently received international acclaim for having achieved national food security following a long period characterized by chronic food production shortfalls. Food production in the country has indeed increased dramatically, thanks in part to large investments in fertilizer subsidies. Maize production almost tripled between the drought-affected 2005 harvest and 2007 (Figure 1), leading the Government to negotiate a deal to export 400,000 tons of maize to Zimbabwe. The combination of favorable rains and fertilizer use helped Malawi achieve a high maize harvest in 2008 as well, and a surplus is expected again in 2009. In recognition of these achievements, the President of Malawi, Bingu wa Mutharika, received the prestigious Agricola Medal from the Director General of FAO for “transforming the country’s economy from a state of food deficit to a net exporter of maize”. The regional Food Agriculture and Natural Resources Policy Analysis Network (FANRPAN) likewise awarded the President its first Food Policy Leadership award for “transforming the country from a food importer to a food exporter”.

![Figure 1. Maize production, Malawi, 1980-2008](image)

While the benefits of fertilizer use are undisputed, rising maize prices have raised questions about the size of the production gains achieved in Malawi. In 2007, rising domestic prices undermined the country’s efforts to sell 400,000 tons of maize to Zimbabwe (Figure 2). Despite estimates of a 1.2 million ton grain surplus, grain shortages started to appear six months after the harvest. The estimated harvest in 2008 was said to be the second largest in the nation’s history. Yet three months after the harvest, the Government instituted price and trade controls in an effort to limit the rise of consumer prices.
By September 2008, maize sales from the parastatal Agricultural Development and Marketing Corporation (ADMARC) were being rationed. Nonetheless, by January 2009, average prices in the informal market had reached record levels.

Several explanations have been offered for such unprecedented increases in consumer prices following seasons of record harvest. The Government has put forward three explanations. The first is that Malawi experiences 30% to 40% grain losses in storage, though the last formal estimate from the Ministry of Agriculture placed the figure at 13%. The second is that private traders have been hiding large stocks in an effort to drive up prices. The third is that private traders have been hiding large exports to neighboring countries. There is little evidence to support these charges, however, so the most likely explanation for the rise in maize prices is that national production estimates have been systematically biased upwards.

**Fertilizer subsidies:** Malawi’s Agricultural Input Subsidy Programme (AISP) has recently received a lot of attention, but it is important to note that the country has been subsidizing the distribution of fertilizer to small-scale farmers since the early 1990s through various projects and programs (Table 1). Throughout most of this period, the majority of smallholders were given 10 to 15 kg of free fertilizer, along with a few kilograms of hybrid or open-pollinated maize seed. However in 2005/06, the magnitude of the Government’s effort increased sharply. Under AISP, almost 1.5 million smallholders – nearly half of all small-scale farmers in the country – were provided a 70% subsidy on 100 kilograms of fertilizer, along with a small allotment of open-pollinated maize seed.

<table>
<thead>
<tr>
<th>Program</th>
<th>Years</th>
<th>Fertilizer</th>
<th>Maize seed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Universal Fertilizer Subsidy</td>
<td>1990/91-1995/96</td>
<td>5 to 10 kg basal and/or top dress</td>
<td>n.a.</td>
</tr>
<tr>
<td>Agricultural Productivity Investment Programme</td>
<td>1997/98-2002/03</td>
<td>5 to 10 kg basal and/or top dress</td>
<td>n.a.</td>
</tr>
<tr>
<td>Targeted Inputs</td>
<td>2000/01-2004/05</td>
<td>5-10 kg basal and 5-10 kg top dress</td>
<td>2-5 kg hybrid or open pollinated</td>
</tr>
<tr>
<td>Agricultural Input Subsidy</td>
<td>2005/06 – ongoing</td>
<td>50 kg basal and 50 kg top dress</td>
<td>2 kg hybrid or 4 kg open pollinated</td>
</tr>
</tbody>
</table>

Table 1. Malawi: Agricultural input subsidies, 1990-2008

preoccupation of the Ministry’s directorate and of the national extension services.

Table 2. Malawi Agricultural Input Subsidy Program (AISP) cost, 2005/06 to 2008/09

<table>
<thead>
<tr>
<th></th>
<th>2005/06</th>
<th>2006/07</th>
<th>2007/08</th>
<th>2008/09</th>
</tr>
</thead>
<tbody>
<tr>
<td>Program cost</td>
<td>51.0</td>
<td>74.0</td>
<td>115.0</td>
<td>221.4</td>
</tr>
<tr>
<td>(US$ million)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Program cost (%</td>
<td>5.6</td>
<td>8.4</td>
<td>8.0</td>
<td>13.5</td>
</tr>
<tr>
<td>of national</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>budget)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Program cost (%</td>
<td>2.1</td>
<td>3.1</td>
<td>3.4</td>
<td>5.5</td>
</tr>
<tr>
<td>of GDP)</td>
<td></td>
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</table>

Source: Dorward and Chirwa, 2009.

**Why subsidize fertilizer?**: In Malawi, the main justification for enormous public investments in subsidizing fertilizer and other agricultural inputs has been the need to enhance household and national food security. The targeting of subsidies to poorer farmers represents a social welfare investment – the goal is to help these families produce a larger share of their own food requirements. This goal is particularly important given both the volatility of grain prices and occasional uncertainty in grain supplies.

In addition to wanting to safeguard food security of poor households, the Government of Malawi is also concerned to avoid the high costs of maize imports. In years of significant shortage, maize is generally imported by road from South Africa. Maize grain purchased in South Africa generally costs US$ 130 to US$ 150 per ton, and transport costs add US$ 80 to US$ 150 per ton to the delivered price. These transport costs can increase significantly if southern Africa as a whole experiences grain shortages and transport systems become clogged. Mainly for this reason, Malawi seeks to be self-sufficient in maize and would prefer, if possible, to be a maize exporter in most years.

Although subsidies in Malawi started out being targeted mainly at maize, over time they have been extended to a wider range of crops, based on the knowledge that some farmers seek to assure their food security by producing cash crops and buying maize. If cash crops can be made more productive, reckon policy makers, these households obtain more money with which to purchase maize.

**AISP overview**: AISP has a fertilizer-subsidy component and a seed-subsidy component. The Government tenders for the competitive supply of almost all of the fertilizer that is distributed through the Programme. Suppliers are responsible for importing the fertilizer and delivering 50 kg bags to parastatal warehouses run by the Smallholder Farmers Fertilizer Revolving Fund of Malawi (SFFRFM). From these warehouses, the fertilizer is distributed to sales centers run by the SFFRFM or by ADMARC. All of the seed handled by AISP is sourced through the commercial market.

The Government distributes to designated households vouchers redeemable for one 50 kg bag of basal fertilizer and one 50 kg bag of top-dress fertilizer. Voucher recipients are supposed to be members of poor households who would otherwise have difficulty affording fertilizer. They are chosen with the assistance of local authorities. Farmers who grow tobacco, coffee and tea receive only fertilizer vouchers. Farmers who grow maize receive an additional voucher for 2 kg of hybrid maize seed or 4 kg of open-pollinated maize seed. Farmers who do not qualify for fertilizer vouchers generally receive a “flexible voucher” redeemable for maize seed, legume seed or cotton seed.

When farmers redeem fertilizer vouchers, they must pay a top-up amount, whose value is set each year. In 2008/09, the MK 800 per bag top-up payment was equivalent to about 8% of the value of the fertilizer received. No top-up payment was required for redeeming the seed vouchers. Cotton farmers received vouchers for a limited quantity of free pesticides (i.e., no top-up payment was required). Most maize farmers received free access to chemicals for grain storage.

During the 2006/07 and 2007/08 cropping seasons, farmers were allowed to redeem vouchers with private input distributors. This practice was eliminated in 2008/09, allegedly because large numbers of counterfeit vouchers were turned in by private distributors. However there is evidence that most of the counterfeit vouchers were in fact turned in by ADMARC and SFFRFM depots. Questions also arose about whether some vouchers were being improperly redeemed for items other than seed, fertilizer and crop chemicals, such as tin sheets or hoes – although there is limited evidence of this in practice. A more significant problem, at both parastatal and private depots, appears to have been the taxing of voucher redemption. Many farmers apparently were asked to pay more than the stipulated top-up payment in order to redeem their fertilizer vouchers.
Because AISP has grown so large, the Programme plays a dominant role in influencing the development of input markets in the country. Most of the fertilizer and maize seed sold in Malawi now is handled under AISP. In 2008/09, due in part to the rise in fertilizer prices, unsubsidized commercial sales of fertilizer have fallen, and the subsidy Programme may account for over 70% of all fertilizer sales. This means that the subsidy Programme is a major determinant of the development of agricultural input markets. In this context, if AISP fertilizer distribution is restricted to parastatal depots, private retail trade declines, not only for fertilizer but also for complementary inputs such as seed and crop chemicals.

**AISP payoffs:** AISP was formally evaluated in 2006/07, and another evaluation is currently underway. An important objective of these evaluations is to determine the cost-effectiveness of the subsidies. To this end, the authors of the 2006/07 evaluation calculated a series of benefit-cost ratios contingent on maize price, maize yield, and the degree of displacement of commercial fertilizer purchases. Using a set of plausible values for these three key parameters, the benefit-cost ratios ranged from 0.76 (assuming a low maize price, low maize yield, and high level of displacement) to 1.36 (assuming a high maize price, high maize yield, and low level of displacement). The level of benefits delivered by the subsidy depends critically on the quality of Programme management. The displacement of commercial purchases must be reduced below the 30% to 40% levels apparent in 2006/07. Fertilizer must be delivered and applied on a timely basis. Benefits are also influenced by the crop management capacity of farmers, because good weed control helps assure higher yields. Finally, the returns to fertilizer subsidies are higher when the country is a net importer of maize, rather than a net exporter, because when the country is a net importer the incremental maize production is valued at the (high) import parity price and not the (low) export parity price.

**AISP prospects:** To date the Government of Malawi has not given any indication that it plans to scale back the size (and cost) of AISP. Nor has it announced any plans to encourage farmers to graduate from the Programme. On the contrary, it has already announced that farmers will pay 40% less for fertilizer in 2009/10 than they paid in 2008/09.

The development partners who directly or indirectly support AISP are encouraging the Government to explore ways of improving the Programme’s efficiency, with an eye to reducing the heavy fiscal drain posed by the very high overall cost. Some relief will surely come from the sharp decline in the costs of fertilizer on international markets that began in the latter half of 2008. There is also talk of reducing the crop coverage by barring tea and coffee farmers from participating in the Programme, although tobacco and cotton farmers would continue to be eligible. While the total number of beneficiaries is expected to increase, proposals are being drafted to improve the targeting to ensure that only the poorest households receive vouchers. Finally, suggestions are being considered for improving the security measures necessary to reduce acceptance of counterfeit vouchers (Ministry of Agriculture and Food Security, 2009).

**Improving the efficiency of the subsidy:** Policy makers and AISP administrators continue to debate whether and how the input subsidies should be targeted. Some argue that a universal subsidy would save money, because it would be very easy to administer, but others contend that a universal subsidy would be inefficient because it would greatly increase the displacement of commercial input purchases. On the other hand, even with vouchers, displacement is taking place. Dorward et al. (2008b) estimate that in 2006/07, upwards of 40% of commercial fertilizer sales were displaced by AISP. If displacement is regularly taking place on this scale, it would be very inefficient because it would mean that public funds are being used to pay for large quantities of fertilizer that farmers would normally be willing to purchase themselves.

The efficiency of the subsidy could also be improved by reducing the amount of fraud and corruption in the distribution and redemption of vouchers. It has been suggested that the vouchers should be printed outside the country, to improve the security measures and reduce counterfeiting. Plans are being floated to strengthen the central logistics unit to improve (i) monitoring of fertilizer imports and tracking of shipments to rural distribution points and (ii) overseeing the allocation and redemption of vouchers.

**Reducing the costs of fertilizer:** The main justification for the subsidy Programme is that farmers cannot afford improved agricultural inputs, particularly fertilizer. The implication is that if the price were reduced, farmers would be able to purchase inputs on their own, making the subsidies unnecessary. A number of proposals have been advanced for reducing the cost of fertilizer, and some of these are currently under evaluation.
Domestic manufacture of fertilizer is one obvious option for reducing costs. This could be based on local production using domestic materials (e.g., through exploitation of the country's rock phosphate deposits) or local blending of imported raw materials. Opportunities for local manufacture or blending of imported raw materials are also being pursued at the regional level in eastern and southern Africa.

A second option for reducing the cost of fertilizer may be to pursue bulk imports, with an eye to capturing quantity discounts. However a potential problem associated with bulking of imports is that it could invite collusion among suppliers unless contracts are competitively negotiated. Opportunities for bulking of fertilizer imports are also being pursued at the regional level in eastern and southern Africa.

A third option for reducing fertilizer costs is to reduce marketing margins in the distribution chain. The Citizen's Network for Foreign Affairs and AGRA have supported training of agro-retailers in an effort to improve business practice, and create a more competitive inputs market. Unfortunately these efforts are now being undermined by the termination of private sector participation in the redemption of fertilizer vouchers.

A fourth option for reducing the cost of fertilizer is to change the composition of the basal fertilizer being supplied for maize. Malawi purchases an expensive compound made up of 23% nitrogen, 21% phosphorous, no potassium and 4% sulfur. Data from fertilizer field trials suggests similar yields could be achieved with a less expensive formulation of 20% nitrogen, 10% phosphorous, no potassium, and 4% sulfur.

**Increasing returns to fertilizer:** Changing the composition of the basal fertilizer being used for maize offers an easy means to reduce fertilizer costs. It could also bring an additional benefit in the form of increased productivity, because soil tests suggest that phosphorous is not the most limiting factor in most of the nation's soils. More generally, substantial opportunities exist to better target nutrients to the varying soil and rainfall conditions throughout the country. Rather than offering every smallholder the same fertilizers, productivity gains could be derived from targeting nutrients by agro-ecology and yield target.

The Government faces a difficult trade-off between investing in subsidizing more fertilizer to achieve production gains in the short term and investing in research and extension systems to improve fertilizer productivity in the medium and long term.

That the subsidy Programme is already exacting an opportunity cost can be seen in the limited investments currently being made in research and extension activities that could improve the efficiency of fertilizer use. For example, very limited funding is available to promote the application of rotations with nitrogen-fixing legume crops and the use of manure. Similarly, very little is being done to evaluate how the returns to fertilizer among poorer households could be increased using techniques such as micro-dosing.

Last but not least, the returns to fertilizer applied to maize are bounded by the level of maize farm gate prices. These are constrained by high transport costs and the poor quality of many rural roads. On the other hand, since only about 15% of all maize farmers sell grain, and these households tend to own more assets than the average household, selling prices are relatively less important for poorer households.

**What alternatives to AISP?:** While considerable attention is being addressed to improving the efficiency of AISP, some have argued that the objectives of the Programme could be achieved more reliably through alternative types of programs. These are worth mentioning, because they call into question the logic of continuing AISP.

While the primary objective of AISP is to improve household food security, it is possible that this objective could be more reliably achieved by lowering consumer prices for maize grain. This is an important insight, because despite the achievement of record levels of estimated maize production, during the past two seasons Malawi has experienced abnormally high maize prices. In recent years, Malawi has experienced some of the greatest volatility in maize prices of any country in southern Africa. This induces risk-adverse households to continue growing maize, instead of diversifying into other, higher value cash crops. And it undoubtedly contributes to higher malnutrition levels among poorer households that are unable to afford to buy grain when prices rise. The Government has started to adopt risk-management strategies in an effort to reduce this price volatility. These include weather insurance, price hedging and improved warehousing. Malawi is also reexamining the appropriate size and spatial distribution of its strategic grain reserve.

A growing debate has also promoted consideration of the trade-offs between subsidizing maize fertilizer and providing poorer households with cash transfers. Each year an unknown
proportion of the recipients of subsidized fertilizer either sell their vouchers or sell the fertilizer they receive because they need the cash for alternative purchases. Malawi is currently finalizing a national social protection policy and broadening experimental investments in cash transfer programs. One of the largest national social protection programs offers both direct cash payments to households with limited labor and cash for work. Recent monitoring efforts highlight the multiplied gains in community incomes derived from these transfers. Better monitoring of the investments being made with these transfer programs can offer a valuable indication of where most farmers believe they can obtain their highest investment returns.

Building viable fertilizer markets in Malawi: The strong commitment of the Government of Malawi to making fertilizer cheaply available to the nation’s farmers has received extensive coverage in the international media. This commitment is grounded in the belief that the benefits of increased fertilizer use – increased food production, enhanced household food security, and reduced reliance on food imports – outweigh the considerable financial costs of the subsidy. In this context, the fertilizer policy debate in Malawi has tended to revolve not so much around whether fertilizer should be promoted and under what circumstances, but rather around how fertilizer should be procured and distributed to farmers at affordable prices. Many politicians in Malawi share the view that fertilizer is expensive, so it must be subsidized. These same politicians believe that subsidies should continue indefinitely, as long as the circumstances that create the need for fertilizer continue to prevail.

Given this motivation, it is interesting that AISP involves the use of vouchers. Normally vouchers are used to steer subsidies to particular groups of intended beneficiaries and/or to encourage purchasing of fertilizer from private distributors. Neither of these rationales is relevant in Malawi at present, since the coverage of AISP has become almost universal, and since private traders are barred from participating in retail fertilizer distribution activities. So vouchers seem like an unnecessary complication.

The Government of Malawi says it has chosen to exclude private traders from participating in the AISP voucher program because it does not trust them to abide by the rules of the program. It is alleged that in the past many traders accepted vouchers as payment for goods other than fertilizer, but this has not been documented conclusively. Ironically, even though private traders are currently barred from accepting AISP vouchers, many of the larger traders support AISP, because they are still allowed to participate in international procurement of fertilizer. These traders know they can make attractive profits by importing fertilizer in bulk, selling it to the Government, and delivering it to one of three main warehouses in the country.

Up until now, the Government of Malawi, with help from some donors, has been willing and able to support the high fiscal costs of fertilizer promotion programs. Should this cost become unsustainable, as many observers have predicted, then it will be necessary to devise an exit strategy. At that point, the case for building viable private sector-led fertilizer markets will become paramount.

What policy measures could be implemented to soften the impact of the Government’s eventual withdrawal from fertilizer procurement and distribution activities while laying the groundwork for private operators to step in? To begin with, farmers could be weaned from direct subsidies on the retail price of fertilizer by having the size of the top-up payment increase over time. The adjustment process could be made more market friendly by allowing competitive forces to determine the size of the top-up payment. For example, for a 50 kg bag of urea, the Government could agree to pay the first Kwacha 4,000, and farmers would have to pay anything above that amount. Fertilizer companies would be free to set the final price paid by farmers, and those offering higher prices would sell less.

Measures designed to phase out direct subsidies on retail fertilizer prices could be combined with measures designed to strengthen private fertilizer distribution systems. Different options can be envisioned. For example, fertilizer transport costs could be subsidized, either across the board (e.g., by arranging for shipment to rural distribution points via Government-owned vehicles) or selectively (e.g., by offering retailers a bonus for fertilizer sold through shops located in remote areas). Similarly, Government funds could be used to provide partial loan guarantees on inventories held by retailers. The purpose of these measures would be to encourage the expansion of competitive trade as a means to reduce costs and promote price discipline.

Rwanda: Agriculture is the backbone of Rwanda’s economy, accounting for about 32% of GDP, 80% of employment, and 63% of foreign exchange earnings. In addition to being economically
important, the agricultural sector plays a key strategic role in ensuring national food security, contributing 90% of the country’s food needs. Because of its large size, the agricultural sector is one of the key engines of growth for Rwanda (Table 3).

Rwanda has slightly more than 1.5 million hectares of arable land, 90% of which is found on hillsides. Because the country’s population density is the highest in Sub-Saharan Africa (355 inhabitants/km²), most arable land is already being used. Rwandan agriculture faces several major challenges: (i) a binding land constraint that rules out bringing more land under cultivation; (ii) small average land holdings of 0.3 hectares; (iii) poor water management resulting from very low levels of irrigation (only 15,000 hectares are irrigated in the entire country); (iv) low levels of improved input use; (v) lack of extension services; and (vi) the limited commercial orientation of most farmers, who are constrained by poor access to output and financial markets.

With the country’s land frontier effectively exhausted, future agricultural growth will have to come from intensification of existing farming systems. Agricultural intensification must take place in the context of a potentially fertile, but challenging, physical environment. Steep terrain makes good land husbandry a strict necessity to curtail erosion and otherwise maintain the quality of the soil, as well as an environmental prerogative. Arable land on hillsides constitutes the vast majority of the total agricultural land in the country, but erosion washes away 1.4 million tons of fertile soil per year. Given the high dependence on rainfed agriculture, irrigation is critical to reducing the sector’s vulnerability to climatic variation and increasing incentives for intensification. Keeping of livestock- and fisheries-related activities are gaining in importance, but production of crops – both food crops and cash crops – still contributes the lions’ share of agricultural output and growth. In 2008, food crop production registered substantial growth over the previous year (16.4%), largely due to Government investment in food crops through the Crop Intensification Programme (CIP).

**Fertilizer use in Rwanda is low:** Although reliable data are lacking, recent estimates put average fertilizer use between 4-10 kg/ha annually (MINAGRI, 2007), among the lowest in the world. The low level of fertilizer use provides grounds for concern, because soil nutrient mining is taking place as farmers extract more nutrients from their fields than are being replaced. Henao and Baanante (2006) estimate that the average annual rate of soil nutrient loss is around 77 kg/ha. This very high rate is largely due to the combined impact of erosion, high population pressure that pushes farmers onto marginal land and reduces or eliminates fallowing, and the widespread presence of acidic soils that constrain fertility and diminish fertilizer response (IFDC, 2008). For these reasons, efforts to promote fertilizer use in Rwanda are increasingly being mounted in tandem with efforts to promote sustainable land management practices designed to curb erosion, improve soil structure and improve soil composition. A recent needs assessment commissioned by the Rwanda Ministry of Agriculture and Animal Resources (MINAGRI) estimated the annual fertilizer needs of the country at nearly 56,000 mt.

Farmers in Rwanda use both organic fertilizer and chemical fertilizer. All of the chemical fertilizer is imported. Imports have fluctuated over the years, reflecting changes in domestic policies as well as the effects of pronounced variability in international fertilizer prices. Figure 3 shows an important rise in fertilizer imports beginning in 2006. Fertilizer imports peaked at nearly 23,000 mt in 2007 before falling to 16,827 mt in 2008, when international fertilizer prices rose meteorically.

In 2007, fertilizer use was distributed across various crops, with most used on tea (45% of all fertilizer), followed by potato (28%), rice (6%), coffee (1%), and other crops (21%) (MINAGRI, 2007). This pattern likely differed from earlier years, because 2007 was

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<tbody>
<tr>
<td>Total GDP</td>
<td>10.5</td>
<td>0.3</td>
<td>5.3</td>
<td>7.2</td>
<td>7.2</td>
<td>7.9</td>
<td>11.2</td>
</tr>
<tr>
<td>Agriculture</td>
<td>10.2</td>
<td>-4.7</td>
<td>0.1</td>
<td>4.8</td>
<td>1.1</td>
<td>0.7</td>
<td>15.0</td>
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<tr>
<td>Industry</td>
<td>7.9</td>
<td>3.0</td>
<td>12.8</td>
<td>7.5</td>
<td>10.9</td>
<td>10.2</td>
<td>10.7</td>
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<tr>
<td>Services</td>
<td>10.6</td>
<td>4.5</td>
<td>7.9</td>
<td>9.1</td>
<td>10.9</td>
<td>12.8</td>
<td>7.9</td>
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Source: World Bank 2009, MINECOFIN
the first year of the Government’s CIP, which promoted fertilizer use on food crops – potato and wheat in the north, maize in the east and cassava in the south. In addition to these food crops, CIP also targeted cash crops in the west.

In 2008, fertilizer use shifted even further to food crops, in part because of the lingering aftermath of a downturn in coffee production, but also because of the Government’s decision to promote food crops in response to the global food price crisis. Roughly 83% of the fertilizer imported in 2008 was used on food crops, primarily maize, wheat, rice and potato (the remaining 17% was used mainly on tea). The amount of fertilizer used in Rwanda falls well short of estimated national fertilizer requirements. The quantity of fertilizer imported in 2008 represented just 30% of the country’s estimated total needs and only 45% of the estimated food crop needs.

**Reasons for historical low fertilizer use in Rwanda:** Fertilizer use in Rwanda is low for many of the same reasons that fertilizer use is low in Africa more generally. On the demand side, incentives to use fertilizer are undermined by the variability of crop yields, attributable to the country’s high dependence on rainfed agriculture. Until quite recently, the relatively high cost of fertilizer compared to output prices provided further disincentive. Because Rwanda is a land-locked country, international transport costs are especially high, as reflected in the fact that fertilizer is typically up to 50% more expensive in Rwanda than in neighboring Kenya. Where demonstration plots and associated extension information have been provided, Rwandan farmers have begun to appreciate the value of fertilizer, but such appreciation is not yet widespread. Even when farmers are convinced of its value, their ability to purchase fertilizer is often constrained by a lack of access to finance. Supply side constraints are in part a consequence of the demand side issues. Fertilizer distribution may be unprofitable because of the weak level of effective demand, as well as the relatively high cost of procuring fertilizer in small, fragmented orders that then must be transported overland at great expense.

Although the prospects for fertilizer market development in Rwanda are constrained by many of the same factors found elsewhere in Africa, at the same time it is important to note that Rwanda differs from most other African countries in three respects. First, the potential demand for fertilizer in Rwanda is not dispersed widely. The country is small and very densely populated – as densely populated as the South Asian countries were when fertilizer use took off in those countries. Second, public expenditure management in Rwanda is widely acknowledged to be unusually transparent, with high levels of
accountability. Third, the Government of Rwanda tends to take a very tough stance on corruption, both at the national and local levels.

Policy and market structure for fertilizer in Rwanda: Faced with declining agricultural productivity, the Government of Rwanda first showed an interest in promoting fertilizer during the late 1980s. At that time, agricultural programs and projects began to distribute fertilizer to farmers, often free of charge. These programs, which were maintained over many years, did not result in any measurable increase in the commercial demand for fertilizer, even when the price was subsidized.

In 2002, the Government introduced policies that favored a more market-oriented approach to the development of the fertilizer sector. In an effort to create greater profit opportunities for private operators, unauthorized distribution of free or subsidized fertilizer was made unlawful, and import and custom duties on fertilizer were suspended. In 2006, a subsidy was introduced covering transport costs from Kigali to remote production zones. In 2008, the food crisis response year, the subsidy was extended to cover the full cost of inland transportation from the coastal ports, which had risen from US$ 160/mt in 2006 to US$ 200/mt by 2008 (IFDC, 2008).

Despite these efforts, fertilizer markets in Rwanda remained thin, and few private operators established a presence in the industry. Importing of fertilizer by private traders continues to be negligible, with virtually all importation being done by Government agencies (most notably OCIR-Thé and OCIR-Café, the national tea and coffee boards), as well as by donor-financed projects. Most fertilizer imports take the form of small orders placed individually on international markets. There is no domestic fertilizer manufacturing capacity and only one small fertilizer blending plant in the country, located in Kigali, with the capacity to blend and repackage. Private fertilizer distribution networks are still very underdeveloped. A recent survey carried out by IFDC identified about 40 private fertilizer dealers in Rwanda, but in 2008 when MINAGRI assessed the capacity of these dealers, only 29 were deemed competent.

Given the lack of capacity in the private sector to procure fertilizer efficiently, in 2006 the Government took steps to capture economies of scale through bulk fertilizer procurement. With the help of experts engaged by the Clinton Foundation, a bulk order was placed combining the fertilizer needs of OCIR-Thé and OCIR-Café and augmented by a US$ 3.5 million grant from the Foundation to pay for fertilizer needed for food crops. Following its reception in Rwanda, the fertilizer was sold to farmers at the actual import cost (border price). Domestic transport costs were absorbed by the Government. Encouraged by the initial experience, the Government thereafter continued its policy of bulk procurement, without further support from the Clinton Foundation. The following year, 2007, the bulk procurement coincided with the initiation of the CIP. Bulk procurement took place again in 2008. The Government is currently engaged in discussions with its East Africa Community (EAC) neighbors to negotiate a bulk purchase at the regional level.

Crop Intensification Programme (CIP): In 2007, the Government of Rwanda launched the Crop Intensification Programme (CIP), whose objectives included raising productivity in leading food crops, boosting food production, and safeguarding national food self-sufficiency. Under CIP, the Government procured improved seed and fertilizer, which it distributed to farmers in selected zones chosen for their food crop production potential. During the first year of the Programme, roughly 9,000 MT of fertilizer were imported and distributed by MINAGRI. Yields of CIP target crops showed positive results (for example, wheat yields more than doubled, and maize yields increased by about 90%).

Input distribution activities carried out by the Government during the first year of CIP yielded a number of important lessons. In particular, the Government’s self-assessment of the CIP experience in 2007 pointed to the role of the public sector in fertilizer distribution in explaining the poor cost recovery of fertilizer advanced to farmers. Only 5% of the value of the fertilizer that was distributed was ultimately recovered. This outcome was not entirely surprising, since in Rwanda, as in many other countries, Government loans to farmers are generally regarded as gifts, and since the business of loan recovery is in any case extraneous to other Government activities. The self-assessment flagged the loan recovery rate as a major impediment to the sustainability of the Programme.

The 2007 CIP was a pilot program whose principal objectives were to increase food crop productivity and boost food production in the country. Inducing private sector participation in inputs procurement and distribution was not an explicit goal during the first year. In assessing the early performance of CIP, however, the Government recognized the desirability of phasing
out public involvement in the fertilizer sector, and it flagged fertilizer distribution as a key area for reform in the following season.

Response to the 2008 food price crisis: As a land-locked country, Rwanda is particularly vulnerable to unfavorable developments in global markets, because increases in prices of imported commodities are often compounded by concurrent increases in fuel and transport costs. In 2008, with world food prices at historic levels, Rwanda suddenly found itself facing heightened food security concerns. Policy makers therefore turned in the direction of boosting domestic production of food staples—and promptly found themselves facing an astronomical fertilizer import bill. The steep increase in the fertilizer import bill was caused partly by higher prices (the weighted average price of fertilizer formulations imported into Rwanda had almost doubled from 2007 to 2008) and partly by the greater quantities of fertilizer needed for the food price crisis response of expanded food crop production. All told, the Government found itself needing nearly US$ 11 million to supplement what it had planned to spend on fertilizer imports. This gap was ultimately bridged with the help of a US$ 10 million grant from the World Bank-administered Global Food Price Crisis Response Program (GFRP).

In this context, the Government undertook decisive policy actions designed to improve access to fertilizer through the private sector. In addition, the Government boosted efforts to increase availability of improved seed for food crop production. The Government enlisted technical assistance from the World Bank and IFDC, the latter already active in Rwanda through a Dutch-financed project. IFDC technical assistance was requested to develop a market-friendly fertilizer distribution system, in line with the Government’s pro-private sector fertilizer development strategy. Other development partners also participated in the initiative, each contributing to the rapid implementation of a fertilizer auction and voucher scheme for “Season 2009A” (mid-September 2008 to mid-January 2009).

Rwanda fertilizer auction and voucher system (2008): In 2008, the Government of Rwanda and its partners mobilized to put in place an auction system designed to encourage private firms to replace public agencies in retail fertilizer distribution. In an effort to secure the best possible procurement price, the Government placed a single bulk order for fertilizer imports. With the dual objectives of phasing out the business of distribution and attenuating the abnormally high global fertilizer prices prevailing at the time, the Government organized a series of auctions through which fertilizer was sold to private operators. To the extent that winning bids were below the procurement price, the Government subsidized the price of fertilizer at auction level. Ceiling prices (Table 4) were then put in place for retailed fertilizer to ensure that the subsidy was passed to farmers.

In line with the national policy objective of increasing domestic food production, MINAGRI also introduced a fertilizer voucher system, which was channeled through the CIP and which targeted smallholder producers of wheat and maize. Farmers holding vouchers were entitled to a further discount of 50% off the ceiling price for fertilizer. Because a condition of the Programme was that vouchered fertilizer had to be used in combination with improved seed, farmers eligible to receive

Table 4. Fertilizer import and retail prices, Rwanda, 2008

<table>
<thead>
<tr>
<th>Fertilizer type</th>
<th>CIF ex-Kigali (RWF/kg)</th>
<th>Average auction price</th>
<th>Subsidy at auction (%)</th>
<th>Ceiling price (RWF/kg)</th>
<th>Ceiling subsidy (%)</th>
<th>Voucher value (RWF/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urea</td>
<td>508</td>
<td>330</td>
<td>33</td>
<td>410</td>
<td>20</td>
<td>205 b</td>
</tr>
<tr>
<td>DAP</td>
<td>791</td>
<td>470</td>
<td>35</td>
<td>550</td>
<td>30</td>
<td>275</td>
</tr>
<tr>
<td>NPK 17-17-17</td>
<td>613</td>
<td>400</td>
<td>41</td>
<td>480</td>
<td>22</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Exchange rate: USD 1 = RWF 565.

* Subsidies calculated relative to the ex-Kigali CIF purchase price
* Representing an additional 50 percent subsidy.

Source: MINAGRI

Transport costs from the coastal ports of Kenya and Tanzania make imported commodities 40-50% more expensive in Rwanda than the countries of transport origin (IFDC 2008).

“Catalyzing Acceleration of Agricultural Intensification for Stability and Sustainability” (CATALIST).
vouchers had to show that they were in possession of improved seed (farmers who did not already have improved seed were provided improved seed free of charge by MINAGRI). Rice and potato farmers, who required less incentive to take up intensification technology, did not receive fertilizer vouchers, but they were free to purchase fertilizer from private distributors wherever these operated in the country (and not only within CIP zones), at the ceiling price that had been subsidized through the auction system. A public relations and extension team was created to accompany the implementation of the voucher program, to promote awareness of the program and ensure proper use of fertilizer. Finally, when the Government introduced the voucher system, it encouraged financial institutions to increase lending to program participants, both the fertilizer distributors that had participated in the auctions, as well as cash-strapped farmers. The hope was that by leaving the business of lending to financial institutions, fertilizer credit recovery would be considerably better than in the previous year.

Outcome of the 2008 auction and voucher system: With a very tight time schedule for implementation, the auction and voucher system was put in place in just six weeks during August and September 2008, with the goal of making fertilizer available in time for the 2009A season cropping of maize, wheat, potato and, to a lesser extent, rice.6

Auction: MINAGRI established eligibility criteria that private traders had to meet in order to participate in the fertilizer auction, including the presence of a viable distribution network in the districts pertinent to the lots being auctioned. The first auction generated a high level of interest, with 29 qualified bidders participating. The number of bidders fell to 8, 14 and 9 in the second, third, and fourth auctions of the season, respectively. Some decline in the number of bidders was to be expected, since the auction approach was very new in Rwanda, and some of the initial bidders lost interest when they discovered they were less well equipped for profitable distribution than they had estimated. However, the drop in numbers of participants was due as well to poor communication regarding the timing of the later auctions, which occurred because of the tight timetable. Still, even the reduced number of participants ensured an acceptable level of competition and no collusion was observed. The Rwanda auction was judged by IFDC to have been “one of the best first auctions” for fertilizer that IFDC had ever witnessed. All told, over the four auctions related to the 2009A season, 10 bidders submitted winning bids. These bidders represented a mix of private fertilizer dealers, cooperatives, and middlemen. Almost all had previous experience in the fertilizer import business, but as it turned out, they had much less experience in fertilizer distribution.

Out of 14,324 mt of NPK 17:17:17, urea and DAP available in 2008 for distribution through the program, 7,404 mt was sold at auction (52%). A further 1,063 mt (7%) was sold via supplementary contracts7 at auction prices, leaving almost 6,000 mt still in stock at the end of December. For every auction sale, the floor price set by the Government was met or exceeded by bidders (Table 4). The “loss” absorbed by the Government on auctioned fertilizer — effectively a subsidy, implemented at the wholesale level — averaged 33% for urea, 35% for DAP, and 41% NPK 17:17:17 of the ex-Kigali price.8 Retail ceilings prices set on the sale of fertilizers to farmers represented 20%, 30%, and 22% subsidies on the ex-Kigali procurement prices for urea, DAP and NPK, respectively (Table 4). Of the fertilizer sold at auction, some 26% was subject to vouchering through the CIP.

Vouchers: Under the CIP, 18,825 vouchers were distributed, representing enough fertilizer to cover 53% of the area planted to maize and wheat in CIP-targeted areas (equivalent to more than one-third of the total area planted to maize and wheat nationwide in 2008). Use of fertilizer and improved seed for wheat and maize outside the voucher program was observed to be very low. Each voucher provided a 50% discount on 50 kg of urea and 100 kg of DAP — enough to treat one hectare. As mentioned above, participating farmers who did not already have improved seed were provided with 30 kg of maize seed (hybrid or open-pollinating varieties) or 100 kg of wheat seed per voucher. Due to the small landholdings in Rwanda, usually several farmers got together to share one voucher, but the voucher was registered under only one farmers’ name. Because of the practice of sharing vouchers, the total number of farmers who received them can only be estimated based on the observations of the service providers tasked with voucher distribution. The service providers indicated that typically

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6The main rice planting season in Rwanda is Season ‘B’ (roughly February to June).
7Due to the inability of some winning bidders to come up with the needed financing, the unredeemed fertilizer was sold by MINAGRI at auction prices to interested dealers.
8The floor price set by the government was below the historically high import cost of the fertilizer. The government deliberately sold fertilizer at a loss for two reasons: (i) to ensure affordability to farmers as part of the food crisis response, and (ii) to encourage private traders to participate in the auction.
two or three farmers shared vouchers. This suggests that the vouchers benefited an estimated 46,209 farmers, each of whom received enough fertilizer to treat 0.41 hectares, which is slightly above the national average landholding. Assuming an average household size of five people, this suggests that about 230,000 people shared in the impact described in the next section.

The cost of the auction and voucher system during Season 2009A was moderate, especially in light of the extremely high fertilizer prices prevailing at the time in world markets. The auction subsidy (representing the difference between the import price paid by the Government to procure fertilizer in the international market and the average price paid by winning bidders) came to US$ 3.6 million. The voucher subsidy (representing the total value of the fertilizer vouchers that were distributed) came to US$ 1.2 million, for a grand total of US$ 4.9 million in subsidy costs. Operating costs for the program were just under US$ 0.5 million, for a total program cost of around US$ 5.3 million.

To put this figure in perspective, the value of the incremental production of maize attributable to the auction and voucher system was conservatively estimated to exceed the total program cost by a wide margin (see below) – and maize was only one of several crops targeted. These back-of-the-envelope calculations of course give only an indication of the program’s cost-effectiveness. A more complete analysis will be possible only when data are available on production increases in all the affected crops (not just maize), as well as on changes in the use of complementary inputs.

Initial indications of impact: Even at this early stage, three broad avenues of impact can be distinguished for the CIP fertilizer auction and voucher program. The first avenue relates to the impact on CIP wheat and maize production through the voucher program. The second avenue of impact relates to the impact on yields of potatoes and rice – crops which did not receive vouchers, but which benefited from the local availability of affordable fertilizers through the auction and ceiling price policies. The third avenue relates to the impacts on fertilizer use resulting from the strengthening of private distribution channels for fertilizer. While a full assessment of these three avenues of impact would require in-depth evaluations, which have not yet been undertaken, data collected on the numbers of CIP (voucher) participants, crop yields, and crop production, provide an initial indication of the Programme’s impacts. The picture emerging from preliminary quantitative data is supported by qualitative interviews conducted with a range of stakeholders, including MINAGRI staff, development partners, extension and voucher service providers and farmers.

Impact on maize and wheat production: Under CIP, wheat and maize yields increased 16% and 73%, respectively. Uptake of improved inputs for these crops by farmers who did not receive vouchers is thought to have been negligible and area expansion was low (5% maize, negative for wheat) so much of the yield improvement can be directly attributed to the voucher program of improved inputs. Few data are available on farm-gate prices of maize, but the additional maize produced under CIP (75,000 mt) was worth around US$ 30 million dollars at prevailing prices. This would have represented a significant income boost for the roughly 40,000 maize farmers who participated in the Programme and their families, even assuming a less-than-perfect price pass through to farmers. These indicators of impact are only indicative, of course, and there is a need to undertake a thorough impact assessment on income and poverty.

Impact on yields of potato and rice: Only 26% of all fertilizer sold through the auction system was distributed through the CIP via vouchers; the rest (including all NPK 17:17:17) was sold by private distributors at specified ceiling prices. During the period when the auction (and ceiling price) system was in place, national yield and production data were collected through MINAGRI’s annual crop assessment survey. Measuring the impact in any observed yield and output increases at a national level will most likely mute the potential impact of auction-affected yields, given that the quantities distributed at auction account for only 45% of estimated national food crop needs. Nevertheless the crop assessment shows a rise in national yields for potato and rice of 8% and 18%, respectively (MINAGRI, 2009b). National-level data give only a gross indication of impact on the yields of potatoes and rice that stem from the local availability of affordable fertilizers through the auction and ceiling price policies. To fine-tune attribution to the Programme, a crop assessment specific to areas in which distribution networks were supplied through the auction system would have

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9 Kirehe, the district that received almost a third of the vouchers for maize, has a population density that is lower than the population densities found in other districts.

10 Operating costs do not include technical assistance received from the World Bank and IFDC. In addition, the cost to MINAGRI of improved maize and wheat seed distributed under the voucher program was USD 875,646.

11 These costs were judged by MINAGRI to have fallen relative to the cost of the same government-supported CIP fertilizer distribution program of the previous year, despite higher levels of outreach.
to be undertaken, to determine whether yields and production of the target crops differed significantly in those areas compared to other areas that did not access fertilizers, or did so to a lesser degree.

**Strengthening of private fertilizer distribution channels:** The third avenue of impact has a longer term horizon for evaluation. It has already been noted that the auction generated acceptable levels of competition among the participating bidders. Only time will tell whether or not the auction has contributed to the achievement of the Government’s long term goal of launching a sustainable private sector-led fertilizer industry, but this will depend critically on the incorporation of a number of key lessons identified from the 2008 experience in promoting private sector fertilizer distribution:

- **Need for a longer time horizon to organize and communicate the auction:** Although there were enough auction participants to ensure competitive bidding, the number of participants declined during successive rounds of the auction. While this reflected partly the presence during the initial rounds of “entrepreneur-middlemen” with little or no prior experience in fertilizer distribution who later dropped out, the decline was also due to communication difficulties in short time frame.

- **Need for training in fertilizer markets and auction participation for the private sector:** The successful bidders included producer cooperatives (10%), fertilizer dealers (40%), and entrepreneur-middlemen (50%). The inexperience of at least some of those in the latter category resulted in either (i) underestimation of distribution costs, leading to overbidding and eventual losses; and/or (ii) lack of experience in distribution, leading to overestimation of the capacity of the distribution network specified at auction.

- **Need to build capacity for adequate retail distribution networks:** Some winning bidders – especially entrepreneur-middlemen – delivered fertilizer purchased at auction to a central location within a given production zone, but from there they had no means to move the product to more remote areas of the production zone. In a number of cases, MINAGRI was forced to step in and negotiate supplementary contracts with local distributors. Such retail distribution challenges affected roughly 60% of the total volume of fertilizer that was put up for auction.

- **Need to improve access to finance at the auction level:** A few winning bidders were unable to mobilize the bank financing needed to execute their purchases. In these cases, unredeemed fertilizer was re-auctioned, and the bidder disqualified from further participation.

- **Need to improve access to finance at farm level:** Many farmers reported experiencing difficulties in accessing finance to pay even the vouchered cost of fertilizers, due to either a lack of savings or insufficient access to credit from banks and microfinance institutions (MFIs) operating in rural areas. Financing for fertilizer purchases came largely from own-capital (39%) or value chain finance (55%) advanced by distributors (largely facilitated in turn by the Government, which accepted auction payment delays in exchange). MFI finance accounted for only 6%. This was in a sense understandable, given the low level of formal financial inclusion among farmers and the limited time available to properly sensitize MFIs and allow them to set up accounts with potential farmer participants. MFIs also needed the time to implement their own loan evaluation procedures, which are not very expedient.

- **Need to control border leakage:** Some fertilizer apparently made its way out of the country, in violation of Programme rules. Cross-border leakage appears to have been minimal, however, thanks in part to vigorous efforts made by law enforcement agencies to monitor illegal shipments. In October 2008, 14 people including several Government employees and district leaders were arrested and charged with diverting fertilizer to other countries. Twenty-seven others are under investigation to determine whether they also took part in the illegal selling of fertilizer (New Times, 14 October 2008).

Despite these minor difficulties, all of which were overcome, the pilot auction system was considered very successful.

**Conclusions and recommendations:** The Government of Rwanda has conducted an initial self-assessment of the CIP auction and voucher program (MINAGRI, 2009b). Assessed against the Programme’s objectives of increasing fertilizer use, improving food security, and involving the private sector in fertilizer distribution efforts, the outcome of the pilot auction and voucher system was considered positive overall.
Key achievements included:

- Food production increased significantly. Food availability per capita is estimated to have risen from 1,857 kcal in 2007/08 to 2,100 kcal in 2008/09 (MINAGRI, 2009a and 2009c);

- Many food crop farmers used fertilizer for the first time (including the vast majority of vouchered farmers); and

- The fertilizer auction system successfully replaced public distribution of fertilizer with private distribution.

The fertilizer subsidies in the Rwanda Programme were intended to be market smart. Ensuring that the subsidies remain market-smart going forward will go a long way to ensuring the sustainability of some of the Programme’s key achievements.

Key lessons learned that will help to ensure improved performance in the future and continued success include:

- Greater efforts are needed to sensitize farmers about the costs and benefits of fertilizer use, as a way of motivating them to invest in fertilizer;

- More time and some capacity building are needed to enable MFIs to lend farmers working capital; greater savings mobilization among farmers, particularly at current high commodity prices, should be a priority activity among MFIs and rural banks;

- Repackaging of fertilizer into smaller packs would lead to increased uptake of fertilizer, especially for non-CIP crops such as beans that are often grown on very small plots; repackaging of fertilizer into smaller packs would also help to relieve financing constraints, particularly if the fertilizers were packaged (and vouchered) separately for basal dressing (DAP) and top dressing (urea);

- Printing and distribution of vouchers is still costly and efficiency gains are possible; and

- Additional resources are needed for monitoring and evaluation activities to permit accurate and objective impact assessment and evidence-based policy analysis.

**Building viable fertilizer markets in Rwanda:** The Rwanda fertilizer auction and voucher system was put in place at a time when Rwanda’s food and fertilizer markets were experiencing unprecedented turmoil. The operating norms of the system will need to be carefully re-assessed to ensure that they continue to reflect rapidly evolving market realities. For example, it will be important to verify that auction floor prices paid for fertilizer reflect the actual replacement cost of fertilizer as fertilizer prices drop.

Going forward, to maintain confidence among private operators the Government of Rwanda will have to maintain consistent rules of the game and ensure timely redemption of vouchers. Ensuring that the rules of the game continue to promote opportunities for all private operators will be critical to success over the longer term.

The Government should continue to concentrate on playing an enabling role. It should focus on the public goods aspects of fertilizer markets, for example by making investments that increase the profitability and reduce the risk of fertilizer investments made by farmers, that strengthen the capacity of farmers to use fertilizer effectively, or that promote financial literacy.

The dramatic fall in international fertilizer prices that has occurred since the introduction of the auction and voucher system should significantly reduce the level of subsidy and contribute to the fiscal sustainability of the Programme. Even so, the Government is unlikely to maintain its fertilizer activities indefinitely, even at lower levels of support. For this reason, it continues to explore ways to devolve further responsibility to private operators. If this strategy is to succeed, the pace at which the public phase-out strategy implicit in the auction and voucher design will be taken up by the Government should be articulated and clearly communicated to all participants – traders as well as farmers.

**Summary and conclusions**

Fertilizer use will have to increase in Africa if the region is to meet its agricultural growth targets, poverty reduction goals, and environmental sustainability objectives. Policies and programs are needed to encourage fertilizer use in ways that are technically efficient, economically rational and market friendly.

Despite numerous initiatives to promote fertilizer, fertilizer use continues to grow very slowly in most African countries. Why is this? As discussed above, slow growth in the use of fertilizer in Africa can be explained by both demand-side and supply-side factors. Many of these factors are structural in nature, meaning
they cannot easily be addressed by “quick fix” approaches designed to show rapid impacts. Rather, they require consistent policies backed by sustained investments, things that all too often have been lacking in many African countries.

**Insights gained from past approaches**

Many initiatives have been launched to build strong fertilizer markets in Africa, but relatively little progress has been achieved in most cases. This paper has examined selected fertilizer promotion schemes, past and present. The picture that emerges is mixed. Although it is not possible to identify any unequivocal success stories, many of the initiatives have generated some useful insights that can help to inform the design of future programs to build strong fertilizer markets.

**Sasakawa Global 2000:** The primary objective of the SG 2000 program was to demonstrate that technologies are available “on the shelf” to enable doubling or even tripling of food crop yields in Africa. Because the emphasis was mainly on increasing production, little effort was made under SG 2000 (at least not initially) to strengthen inputs delivery markets. It was almost as if the SG 2000 program was designed on the assumption that once the efficacy of seed-fertilizer technology had been demonstrated, input supply would take care of itself. Perhaps predictably, this approach proved insufficient. The production demonstration plots in many cases achieved their objective, but not until the SG 2000 program was well advanced did it become evident that seed and fertilizer supply networks were not going to spring up spontaneously, just because the farm-level technologies were proving to be effective.

**Millennium Villages Project:** The MVP similarly was designed with the primary objective of demonstrating proof of concept – in this case, the concept that an integrated approach to the interlinked problems of food and nutrition, education and health can significantly improve the welfare of poor African villagers. With MVP, the ends justifies the means, and MVP staff have done whatever is needed to ensure that improved inputs for agricultural production are delivered on time and in sufficient quantities to stimulate the desired increases in food production. Often this has meant using political influence to convince public agencies to prioritize the needs of the Millennium Village farmers, who often receive inputs on a priority basis compared to farmers in other villages. Building sustainable input supply systems is not an explicit priority of MVP, so there is little reason to expect that MVP interventions will have a significant impact in terms of laying the groundwork for viable fertilizer markets.

**AGRA’s Soil Fertility Initiative:** While still at an early stage of implementation, the AGRA soil fertility initiative appears to be taking an approach that is fundamentally different from the approaches taken by earlier programs, in the sense that it is explicitly seeking to lay the groundwork for viable private sector-led input markets. Building on the experience of successful pilot efforts supported by The Rockefeller Foundation carried out in eastern and southern Africa over the past 15 years, AGRA seems willing to make the sustained investments that will be needed for input distributors to succeed. These include investments in market infrastructure, financial services for market participants, risk management instruments, and human capital, among others. Time will tell whether this approach can be implemented on a sufficiently large scale to make an impact at the regional and national levels.

**Malawi case study:** Successive governments in Malawi have invested considerable time, effort, money and political capital in promoting the use of fertilizer. Although the performance of Malawi’s various fertilizer promotion schemes remains subject to debate, one thing that is clear is that it has proved difficult to involve the private sector to a meaningful extent in state-supported fertilizer promotion schemes. Lingering mistrust between Government officials and industry representatives has led to the effective marginalization of most private input supply firms, who today play a restricted role in an area of activity that they once dominated. As a result, fertilizer procurement and distribution activities in Malawi today are carried out mainly by ADMARC and other Government agencies, at considerable cost to the national treasury. With no clear exit strategy, and with the cost of the program growing steadily, the Government will be challenged to mobilize the resources needed to sustain the program over the longer term.

**Rwanda case study:** The Government of Rwanda has become involved in fertilizer marketing activities only recently. Faced with the global food crisis, which could eventually threaten national food security, it has acted swiftly to ensure the import and distribution of fertilizer. To their credit, Rwandan policy makers recognize the importance of drawing in private sector participation, with an eye to the eventual disengagement of public agencies. In the absence of proven methods for
Building private sector-led fertilizer markets, they have shown a willingness to experiment with innovative approaches — for example, the fertilizer auction system — that can actively draw in the private sector. Since these approaches are still relatively untested, there is a recognition that occasional temporary setbacks are likely to occur as the Government, its development partners, and private firms engage in what is essentially a process of trial-and-error experimentation to find solutions that will work in the Rwandan context. The importance of tracking progress is therefore not only indispensable to Rwanda, but also to other countries as they seek for more sustainable input market development.

**Entry points for future interventions**

Taking into account lessons learned from past experience, what can be done to build vibrant and sustainable fertilizer markets in Africa? In considering possible entry points for public interventions, it is important to adopt a long-term perspective. Past efforts to promote fertilizer in Africa all too often focused narrowly on stimulating immediate increases in fertilizer use with the help of fertilizer price subsidies — budgetary payments made by governments or development partners to reduce the cost of fertilizer at the farm level. This approach is politically popular, because elected officials like nothing better than to make small handouts to large numbers of farmers who are also voters. It is however also very limited. Governments can do many things to promote fertilizer beyond artificially reducing the cost to farmers through direct price subsidies, and in fact other measures will often be more cost-effective and financially sustainable. Public interventions can be used to help farmers, but they can also be used to help fertilizer importers and manufacturers, fertilizer distributors at the wholesale and retail levels, financial services providers, and other key actors on the supply side. More fundamentally, public interventions can involve not only direct budgetary payments designed to influence fertilizer prices in the short run, but also a wide range of other measures that improve the profitability of fertilizer over the medium to long run by directly or indirectly influencing market prices, costs incurred, or benefits received by consumers and producers of fertilizer.

Building viable fertilizer markets in Africa can be accelerated through use of “market-smart subsidies.” Market-smart subsidies are temporary interventions that work singly or in combination to lower the price and/or improve the availability of fertilizer at the farm level in ways that encourage efficient use of fertilizer while at the same time promoting private investment in fertilizer markets. Market-smart fertilizer subsidies differ from traditional fertilizer subsidies in that they are time bound, do not distort the relative price of fertilizer relative to other inputs so as to encourage excessive and economically inefficient use of fertilizer, and are designed to shift incentives faced by buyers and sellers in ways that are consistent with the development of sustainable private markets for fertilizer. Market-smart subsidies also differ from traditional subsidies in that they target a wider range of potential entry points, not just the price paid by farmers when they purchase fertilizer.

**Demand-side approaches**

Demand-side approaches for promoting fertilizer market development are designed to strengthen demand for fertilizer at the farm level. In market economies, stronger demand at the farm level can be expected to elicit an increase in supply, as profit-seeking input distributors respond to new opportunities to increase sales and income. Demand-side approaches often include extensive fertilizer demonstration programs, often combined with free distribution of sample packs to encourage farmer experimentation. Demand-pull approaches may also involve subsidies, which keep fertilizer prices artificially low and make fertilizer more affordable to farmers facing cash constraints. Subsidies can be effective in stimulating increased use of fertilizer, but in view of the high fiscal and administrative costs of the typical subsidy program, many African countries are seeking a wider range of instruments to strengthen demand. To this end, improving access to finance is an essential parallel development needed to support demand-pull approaches to fertilizer market development. Savings mobilization, capacity building for microfinance institutions, and improving the financial literacy of farmers will go far to relieving what is often a critical constraint to effective demand, namely, farmers’ lack of purchasing power.

**Supply-side approaches**

Supply-side approaches for promoting increased fertilizer market development are designed to improve the availability and affordability of fertilizer in the market. They focus on policy reforms, institutional changes and supporting investments that can make fertilizer production and distribution more profitable. In the short run, increased profitability will encourage suppliers to offer more fertilizer at the prevailing market price. Over the long run, sustained high profitability will draw new firms into the market, increasing supplies. As in the case of liberalization of
food markets, a predictable and rule-based policy environment must be the first priority for making a rapid transition to private fertilizer markets.

In competitive markets, prices are determined through transactions negotiated among many sellers and buyers. In such markets, individual firms cannot influence prices, so their profits depend on the size of their costs. For this reason, many supply-push approaches focus on opportunities to reduce the costs associated with fertilizer production, procurement and distribution. Reductions in the cost of procuring and distributing fertilizer often can be achieved by improving the business environment, reducing logistics costs (especially transport) and improving the availability and lowering the cost of financing. Introduction of risk-management instruments for fertilizer manufacturers, importers and distributors may also be important in raising long-term profitability levels.

Available instruments for building strong fertilizer markets
Sustainable growth in fertilizer use in Africa is unlikely to happen unless resources can be shifted to activities that address the many underlying structural problems affecting incentives to supply fertilizer and to use fertilizer. These activities may include policy and institutional reforms, as well as public investment in infrastructure, knowledge generation and dissemination, capacity building, and improving the resource base on which African agriculture depends.

Policy reforms are needed to stimulate private investment in and commercial financing of the agricultural sector. Relevant options include: trade policies that promote the free flow of goods, macroeconomic policies that facilitate access to foreign exchange, tax policies that do not place an undue tax burden on productive inputs, policies that promote competition by facilitating entry and exit of firms, and land tenure policies that increase farmers’ access to credit and encourage increased agricultural investment.

Institutional reforms are needed to ensure smoothly functioning commercial exchanges at all levels of the value chain. Areas needing particular attention often include: development and implementation of quality controls, enactment and enforcement of contract law, prevention of excessive consolidation of market power, and creation of farmers’ cooperatives and professional organizations.

Investment in infrastructure is needed to reduce fertilizer costs, increase farmers’ share of output prices, and improve the reliability of service (both timeliness of delivery and maintenance of quality of the product). Improvement of the entire range of transportation infrastructure is fundamental to these objectives, including improvement of rural roads, major highways, railways and ports.

Strengthening in agricultural research and extension services is needed to improve their responsiveness to the needs of farmers and to allow them to adapt with greater agility to the commercial realities of the fertilizer sector. Some rethinking about how these services are organized and funded may be necessary, including consideration of public/private partnerships. Also some realigning of the criteria used to develop fertilizer recommendations may be needed to arrive at a cost-effective balance between farmers’ need for location- and farm-specific recommendations, and fertilizer suppliers’ need to limit product variety to realize economies of scale.

Capacity building is needed to improve the knowledge and skills of farmers and commercial actors. Training needs typically differ by cropping system, level of market development, and infrastructure. Key needs include basic literacy and numeracy, business management training, and knowledge of fertilizer products. The problem must be addressed by improved public education systems, as well as through training programs that target the needs of farmers and traders. The Rwanda experience emphasizes the need for capacity support of private sector actors, both in procurement and distribution.

Improvements in the agricultural resource base are needed to help improve the quality of soil and water resources so as to increase crop responses to fertilizer and reduce the risk of crop loss. The potential public-good nature of some of these improvements suggests that governments, possibly in partnership with the private sector, might need to be involved in irrigation and water control, and soil conservation and erosion control.

Guiding principles for fertilizer program design
Faced with the rather daunting list of possible interventions to strengthen fertilizer markets, policy makers often ask what are the most important actions – those that should be taken first. While it would be nice to be able to offer a standard prescription, unfortunately this is not possible. Many constraints
to fertilizer market development recur throughout the region, and the set of constraints that are truly binding tends to vary from country to country. This means that in every individual situation, careful diagnosis is needed to identify interventions that are appropriately tailored to the prevailing circumstances. And it must be admitted that even when the binding constraints have been appropriately identified, it is not always known what interventions will work in a particular setting. For this reason there is merit in continuing to experiment, as long as care is taken to document the results and learn methodically from experience.

In designing interventions to promote increased fertilizer use, policy makers and project designers should bear in mind the following 10 guiding principles if they want to ensure that the interventions will help build strong markets for fertilizer:

1) **Promote fertilizer as part of a wider strategy.** Fertilizer is not a magic bullet. Interventions designed to promote increased use of fertilizer should be developed within the context of a wider sector strategy that recognizes the importance of supplying complementary inputs, strengthening output markets, and appropriately sequencing interventions.

2) **Favor market-based solutions.** Long-term solutions to the fertilizer problem will have to be market-based. Interventions designed to promote increased use of fertilizer should be designed to support market development and not undermine incentives for private sector investment.

3) **Promote competition.** Competition in fertilizer markets is needed to ensure good performance. Barriers to entry into fertilizer distribution should be reduced (except possibly in the very short run), and markets should be competitive to ensure the lowest cost and best quality service.

4) **Pay attention to demand.** Farmers’ effective demand, shaped by the financial profitability of fertilizer use, should be the ultimate driving force of input supply systems and the foundation of a sustainable fertilizer promotion strategy.

5) **Insist on economic efficiency.** Fertilizer promotion efforts should be driven by economic considerations. Interventions designed to promote increased use of fertilizer should be carried out only where it is economically efficient on average to use fertilizer.

6) **Empower farmers.** Farmers should be in the driver’s seat. Interventions designed to promote increased use of fertilizer should empower farmers to make their own decisions on the most appropriate way to manage soil fertility in their particular farming context.

7) **Devise an exit strategy.** Governments should not be in the fertilizer distribution business for the long haul. Public sector interventions designed to promote increased use of fertilizer should be designed with a clear exit strategy, except for a few long-run public-good functions, such as market regulation, infrastructural development and R&D on natural resources management.

8) **Pursue regional integration.** Market size matters, so trade matters. Countries should seek regional integration and harmonization of fertilizer policies to reap economies of size and scope, which are especially important in a region such as Africa with so many small countries.

9) **Ensure sustainability.** Solutions must be designed for the long term. Interventions designed to promote increased use of fertilizer should be economically, institutionally, and environmentally sustainable.

10) **Promote pro-poor growth.** Equity considerations matter. Assuming the previous nine guiding principles have been followed, a final consideration is that public interventions designed to promote increased use of fertilizer should also aim to promote pro-poor growth. In exceptional circumstances, poverty reduction and/or food security objectives may even be given precedence over efficiency and sustainability goals, if it can be determined that fertilizer interventions are a cost-effective way of addressing these problems.

**Final thoughts: Need for further research**

An interesting feature of the policy dialogue surrounding fertilizer market development in Africa is that often it is driven by ideology, rather than evidence. Design of fertilizer policies and programs in Africa continues to be hampered by a lack of up-to-date and reliable data on the coverage and impacts of existing initiatives. Thus there is a need to strengthen monitoring and evaluation efforts, to shed additional light on what works and what doesn’t work with regard to fertilizer market development.
initiatives. Needed also are more and better ex-post impact assessment studies, which tend to be technically challenging because of their inherent complexity and because the difficulty of measuring key parameters such as yield increases and income gains. More and better empirical information is needed to make fertilizer policy analysis more results based and less subject to political manipulation.

Areas in which additional research is needed to inform the design of future interventions include the following:

- **Financial profitability of fertilizer use.** The reluctance of farmers in Africa to use fertilizer may be rational if investment in fertilizer is financially unprofitable. Under what conditions is fertilizer use financially profitable? The answer to this most basic of questions is likely to vary depending on the crop, on agro-climatic conditions, on the production technology, on prices of inputs and outputs, among other factors.

- **Economic profitability of fertilizer use.** Even in cases where fertilizer use is financially unprofitable, if market prices do not reflect the true opportunity cost of production inputs and outputs, it is possible that fertilizer use is economically profitable. Under what conditions is fertilizer use economically profitable? In order to answer this question, it is necessary to identify distortions in the economy that may be driving a wedge between financial economic prices.

- **Impact of fertilizer programs on crop yields and production.** Fertilizer promotion programs generate benefits only if they succeed in significantly raising yields in zones where crops are currently being grown or in encouraging farmers to increase the area planted. To what extent do fertilizer promotion programs lead to improved yields, expanded area, or both?

- **Economics of manufacturing fertilizer locally.** The recent spike in fertilizer prices in international markets has led to calls for the development of local manufacturing capacity in Africa. But would investing in local manufacturing capacity reduce the cost of fertilizer more than, say investing in improved port facilities and better domestic road and rail networks?

- **Benefits of bulk purchasing.** Analysts say that a major factor contributing to the high cost of fertilizer in Africa is the small size of fertilizer markets, which prevents suppliers from capturing economies of scale. Efforts are being made in a number of countries (and in same cases among groups of countries) to pool orders as a way of obtaining price discounts and lowering unit transport costs. Does bulk purchasing really deliver cost savings as has been claimed?

- **Displacement of commercial purchases by fertilizer subsidies.** Fertilizer programs involving the use of subsidies will fail to generate incremental benefits if distribution of subsidized fertilizer merely has the effect of displacing commercial fertilizer sales. To what extent does distribution of subsidized fertilizer lead to additional use of fertilizer?

- **Returns to public investment in fertilizer programs.** Public support of fertilizer promotion programs – including fertilizer subsidies – is justifiable only if resources invested in such programs deliver attractive returns relative to alternative investments. What are the incremental benefits generated by public investment in fertilizer programs, and how do those returns compare to returns from investments in alternative activities?

**References**


