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Fertilizer market development: a comparative analysis of Ethiopia, Kenya, and Zambia

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Abstract

This article synthesizes case studies from Kenya, Zambia, and Ethiopia to assess how differences in the implementation of fertilizer marketing policies have affected the costs and risks borne by marketing actors, the investment response by private traders, and fertilizer consumption.

Financial cost accounting techniques indicate that domestic marketing costs account for 50% or more of farm-gate prices. The sum of importer, wholesaler and retailer profit margins generally account for less than 10%. There are opportunities to reduce domestic marketing costs through the following: reducing port fees, coordinating the timing of fertilizer clearance from the port with up-country transport, reducing transport costs through port, rail, and road improvements, reducing high fuel taxes, and reducing the uncertainty associated with government input distribution programs that impose additional marketing costs on traders. Estimated reductions in the farm-gate price of fertilizer from implementing the full range of options identified in each country range from 11 to 18%. Price reductions of this magnitude, if passed along to farmers, would increase farmers' effective demand for fertilizer. Investments in selected publically provided goods, often considered outside the scope of fertilizer marketing policy per se, strongly affect the costs of fertilizer, farmers' willingness to pay for it, and hence the performance of markets.

Keywords: Fertilizer; Marketing; Agriculture; Africa; Kenya; Ethiopia; Zambia

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Introduction

African farmers typically pay considerably higher prices for fertilizer than farmers in most other parts of the developing world.[1] However, there is a dearth of empirical analysis on why fertilizer prices in Africa are so high, and what could reasonably be done to make fertilizer more affordable and profitable for farmers to use it. A better understanding of the costs and risks in input marketing can shed light on current debates over the need for direct government intervention in input marketing, public goods investments, and policy changes to enable the private sector to better meet the needs of small-scale farmers.

This paper has four objectives: the first is to examine how differences in the implementation of fertilizer marketing policy have affected the private sector's behavior, fertilizer marketing margins, and fertilizer consumption levels, based on the cases of Kenya, Zambia and Ethiopia. These countries have pursued very different approaches to fertilizer market development since 1990 and offer important comparative insights. Our second objective is to provide a conceptual framework of the factors affecting fertilizer demand and link this framework to discussions of "market failure." Third, the paper decomposes the sources of domestic fertilizer marketing costs using financial cost accounting techniques. Lastly, drawing from the foregoing, we identify organizational and institutional changes that could reduce fertilizer marketing costs, and simulate the effects of these potential cost reductions on the profitability of using fertilizer on maize production.

Conceptual framework: a systems approach

Agricultural input marketing plays an important role in the structural transformation of an economy from subsistence-oriented production toward an integrated economy based on specialization and exchange. Whether the benefits from specialization and exchange are actually achieved depends on the costs of exchange within the economy. These costs are determined by the functioning of exchange systems, i.e., the processes through which people carry out economic transactions. The weaknesses of exchange systems in much of sub-Saharan Africa are reflected in the thinness, volatility, and unreliability of markets, the overwhelming predominance of spot markets as opposed to more complex and formalized market structures, the risks and costs of transacting in environments where contract enforcement processes are costly and uncertain, and the difficulties of developing institutions to

[1] For example, mean prices paid per metric ton for urea in 1998 and 1999 were US$201 for India, $332 for China, $254 for Bangladesh, $310 for Pakistan, $372 for Thailand, $265 for Brazil, and $319 for Columbia. By contrast, prices paid per ton for urea over the same period in the following coastal countries of Africa were $408 (Kenya), $543 (Nigeria), $340 (Madagascar), and $612 (Cameroon). These figures were derived from FAOStat (2003) combined with exchange rate information from the United Nations (2002).

effectively coordinate activities among marketing actors at a particular stage in the system and across the different stages of the system (Shaffer et al., 1985).

The ability to capture the gains from specialization is limited by the size of the market, which is in turn influenced by effective demand relative to the sum of production and marketing costs. Where these expected costs exceed the expected gains from exchange, no transaction takes place. High exchange/marketing costs (e.g., transport, storage, handling, transaction costs, etc.) therefore can prevent what would otherwise be beneficial trades and depress the development of exchange-based economic systems required for structural transformation. Because households face varying marketing costs and resource endowments, the extent of market participation varies across households (De Janvry et al., 1991).

Regarding a purchased input such as fertilizer, farmers' willingness to pay is a reflection of the average value product of using the input. The average value product of an input is also household-specific, reflecting differences in soil quality, household resources, management practices, access to output markets, and other factors affecting the profitability and riskiness of using fertilizer. If input markets functioned efficiently, traders would supply inputs if the following condition is satisfied for a sufficient number of farmers in the area:

$$E(\mathrm{WTP_i}) > \mathrm{P_i} \tag{1}$$

where $E(\mathrm{WTP_i})$ is the expectation of farmer i's willingness to pay for the input, and $\mathrm{P_i}$ is the competitive cost of the input to farmer i, including transaction costs.[2]

The observation that only a small proportion of small-scale farmers use fertilizer in a given area is sometimes attributed to "market failure". While the term is rarely defined, its growing use derives not primarily from rigorous evidence of allocative inefficiencies, i.e., that the market fails to supply fertilizer to a particular area even though condition (1) holds for many farmers.[3] Our interpretation is that the meaning of "market failure" has been substantially broadened in recent years to include situations where—because of the high overall costs of exchange compared to farmers' willingness to pay, particularly in remote and semi-arid areas—markets are thin and volatile or do not arise at all. Note that this broader meaning of market failure could apply to cases in which the costs of supplying an input to a given area exceed farmers' WTP for it. Ironically, according to standard economic theory, the absence of a market in this case would signify an efficient allocation of resources. If farmers' willingness to pay for an input is not sufficient to justify the cost of supplying the input, then markets cannot be said to fail. However, there is certainly a problem, to the extent that the missing market inhibits the potential for agricultural productivity growth and intersectoral growth linkages associated with structural transformation (Mellor, 1976; Johnston and Kilby, 1975).

[2] This discussion could be motivated in a expected value-variance framework to incorporate the effects of risk, but this would not change the fundamental points of the exposition.

[3] Because of micro-variability in agro-ecological conditions, wide differences in transportation costs, and market conditions which vary over time and space, conclusions of allocative inefficiencies would need to be based on time-specific analyses of localized geographic areas.

Yet it is important to correctly diagnose the source of the problem in order to develop appropriate input intensification strategies. If high costs of exchange are among the central reasons inhibiting the development of markets in underdeveloped areas, then a critical development challenge is how to reduce the costs of exchange. Our approach is thus to take an empirical perspective to the problem by enquiring into the sources of the high costs of fertilizer marketing. Elaborating on Kohls and Uhl's (1985) framework, the domestic marketing component of the farm-gate price of fertilizer can be disaggregated into four types of costs:

- *Type 1 costs:* transaction costs incurred in the coordination of exchange among market actors;
- *Type 2 costs:* transformation costs incurred in physical marketing functions such as transport, handling, and storage, and costs of facilitating functions such as financing and market intelligence;
- *Type 3 costs:* costs from government behavior, including taxes and fees as well as state activities that impose additional costs on other actor's marketing activities;
- *Type 4 costs:* excess profits emanating from non-competitive behavior of marketing firms.

The relative magnitude of these costs, and the potential to reduce them, provide guidance as to the appropriate focal points for public policy. If Type 1 costs are the primary cause of high farm-gate fertilizer prices, then greater fertilizer use will require addressing the causes of high transaction costs. In situations where Type 2 and 3 costs predominate, then an appreciable rise in fertilizer use will require investments to reduce the costs of performing the physical marketing functions. This often requires publically provided goods and changes in the policy environment, to raise the returns to investments by private actors.

Partitioning marketing costs into these categories is difficult in practice because some of these costs are unobserved and are incorporated into the fee structure of other discrete activities. For example, transport cost rates will be higher along routes where security problems increase the risks of trade. The presence of increasing returns in marketing also blurs the distinction between transaction and physical costs. Certain institutional or policy changes could be envisioned to reduce transaction costs and simultaneously provide incentives to invest in new marketing technologies that reduce unit transport or storage costs. With these caveats in mind, we attempt to quantify as accurately as possible the costs incurred in fertilizer marketing through financial cost accounting analyses in Kenya, Zambia, and Ethiopia. We begin with a description of the fertilizer market reform processes in these countries.[4]

[4] Important multi-market interactions between finance, output, and input markets (see Nagarajan and Meyer, 1995) unfortunately cannot be elaborated upon here because of space limitations (see Govereh et al., 2002, Stepanek, 1999, and Yamano et al., 2003).

Description of reform implementation

Kenya, Ethiopia, and Zambia have all pursued an official policy of encouraging private sector involvement in fertilizer marketing. However, they provide interesting contrasts because of the divergent approaches that each country has taken in implementing fertilizer subsector reform. This underscores the importance of studying implementation as distinct from policy pronouncements in assessments of reform outcomes. Understanding ex post outcomes provides a foundation for developing effective ex ante strategies.

Kenya

From 1974 to 1984, the Government of Kenya (GOK) provided a fertilizer importation monopoly to one firm, the Kenya Farmers Association. The monopoly position of KFA was later viewed as an impediment to the development of the fertilizer market, and during the rest of the 1980s, the GOK tried to encourage other firms to enter the market albeit under very tight controls. Fertilizer traders were to adhere to official prices set at 54 market centers throughout the country. The GOK determined which firms were allowed to operate, through licensing requirements and the allocation of foreign exchange (Arwings-Kodhek, 1996). Kimuyu (1994) argues that the licensing process provided rent-seeking opportunities for public sector officials, the costs of which had to be absorbed by trading firms who were mandated to operate within the trading margins afforded by the control price structure. Donor fertilizer aid, accounting for over half of total imports during the late 1980s, were poorly coordinated with commercial imports, leading to frequent oversupply and deficit (Kimuyu, 1994). Morever, the GOK increasingly recognized that its controlled pricing structure did not ensure adequate margins for retailers to supply the relatively distant rural areas. While the controlled pricing structure was designed to improve farmers' access to fertilizer, it had the opposite effect in the more remote areas.

These concerns led the GOK to reform its fertilizer marketing system. By 1993, prices were decontrolled, donor imports dwindled to 5 percent of total consumption, and small-scale farmers relied exclusively on the private sector and cooperatives for fertilizer. Allgood and Kilungo (1996) report that by 1996, there were 12 major importers, 500 wholesalers, and roughly 5000 retailers distributing fertilizer in the country. IFDC (2001) estimates that the number of retailers rose to between 7000 and 8000 by 2000. Some of the largest importers were cooperatives and estate firms supplying their members, most of whom were small-scale farmers participating in tea, coffee, and sugarcane outgrower schemes.

Several studies indicate that there has been an impressive private sector response to fertilizer market reform and that the market is generally competitive, particularly at the retail level (Arwings-Kodhek, 1996; Omamo and Mose, 2001; Wanzala et al., 2002). Freeman and Omiti (2003) conclude that market reform has stimulated fertilizer use in Kenya, mainly by improving farmers' access to the input through the expansion of private retail networks. Nevertheless, marketing costs

remain high, and fertilizer application rates by small-scale farmers are below levels recommended by the national extension service. Smallholders' access to inputs on credit is restricted primarily to those participating in integrated cash crop programs, although evidence indicates that smallholders utilize these arrangements to acquire fertilizer on credit for use on food crops too (Yamano et al., 2003).

Trends in fertilizer prices and domestic marketing margins are important indicators of market performance. Measuring domestic marketing costs is difficult because some of these costs are unobserved and incorporated into the fee structure of other discrete activities. Table 1 presents fertilizer marketing margins between Mombasa port and Nakuru, a relatively accessible area along the major Trans-Africa Highway. Since the introduction of fertilizer market reform in the early 1990s, the marketing margins between Mombasa and Nakuru have declined substantially. During the 1990–95 period, mean domestic marketing costs were $262 per ton, in contrast to $206 per ton between 1996–2000, a 24% decline.

Zambia

Before 1989, fertilizer distribution was the preserve of NAMBOARD, a government parastatal. The Zambian government abolished NAMBOARD in 1989 and initiated a process of fertilizer market reform during the early 1990s. Throughout the reform process, the official objective was to encourage a vibrant private distribution system to serve the needs of small-scale farmers. While private trade has been legalized, the government has continued to distribute large quantities of fertilizer on credit in the major agricultural areas of the country. The government programs have been modified several times during the 1990s ostensibly in response to

Table 1
International and domestic wholesale price differences for DAP and urea fertilizers, Kenya and Zambia (U.S. $ per metric ton)

	DAP, c.i.f. Mombasa (A)	DAP, wholesale, Nakuru, Kenya (B)	difference (Nakuru–Mombasa) (C) = (B–A)	Urea, US Gulf (D)	Urea, wholesale, Lusaka (E)	difference (Lusaka–US Gulf) (F = E–D)
1990	159	391	232	140		
1991	190	458	268	163		
1992	179	503	324			
1993	139	369	230	138		
1994	178	481	303	151		
1995	214	431	217	212		
1996	210	485	275	199	581	382
1997	200	405	205	149	550	401
1998	206	413	207	122	385	263
1999	183	380	197	101	361	260
2000	160	309	149	129	360	231

Sources: Column (A)—Ministry of Agriculture and Rural Development data files. Column (B)—Kenya Farmers Association, Nakuru. Column (D)—Green Markets data files. Columns (E)—Food Reserve Agency/Zambia.

deficiencies noted in donor-funded assessments. Yet three consistent features of the government programs have remained throughout the reform process: First, the government has selected the local "agents" to receive program fertilizer on credit according to procedures that consistently lacked transparency. The agents' role has been to forward the fertilizer to "resource poor" farmers on credit, and then to recover the loans after harvest through maize purchases from the farmer loan recipients. Many of these agents have turned out to be influential local elites or their proxies (Zambia Times, 2000). Second, in each year since 1993, the loan recovery rate was never higher than 43 percent and was typically below 30 percent (Govereh et al., 2002). Accounting systems were unable to determine the extent to which agents or farmers were the source of loan non-repayment. Third, the program had little capacity to target relatively poor farmers with low effective demand. Analyzing national household survey data from 1999/2000, Govereh et al. (2002) found that farmer recipients of government fertilizer tended to have more land, assets and income than non-recipient households. Some analysts have concluded that the program's primary purpose has been to fulfill political patronage objectives through regressively targeted delivery of unrecovered loans to designated local elites (Copestake, 1998; Pletcher, 2000).

These government programs have taken place within an official policy environment of liberalization. The private sector's response to the reforms, in terms of new entry and investment, has been limited. High transaction costs and coordination problems within the private sector may partially account for this, yet there is no doubt that the government's distribution of large quantities of poorly targeted fertilizer on loan with recurrently high default rates has undercut private firms' ability to distribute fertilizer commercially (Govereh et al., 2002). Traders continually complained that uncertainty over the timing, location, and volume of fertilizer distributed under the government programs added risks and costs to their operations, and reduced their participation in the market (Govereh et al., 2002). Moreover, recent analysis has shown that fertilizer use on maize is unprofitable in many areas of the country given the weaknesses of infrastructure, extension services, and systems for generating and distributing improved seed varieties (Donovan et al., 2002). In these respects, the private sector's apparently weak response to input market development may not reflect a "failure" of the private sector or of markets per se, but may largely reflect an underinvestment in traditional public goods (infrastructure, appropriate extension messages, R&D investments) that limit the profitability of using purchased inputs or of producing a surplus for the market. In fact, it appears that fertilizer marketing costs from the US Gulf, to Durban, South Africa, to Lusaka have declined in recent years, although no firm conclusions are warranted in light of the limited availability of time series data (Table 1).

Ethiopia

Fertilizer importation, distribution, and pricing was controlled by a government parastatal starting in 1984 (NFIA, 2001). Starting in 1993, the Ethiopian government (GOE) began curtailing the operations of its official state marketing board

under aid-conditionality agreements with donors. The private sector was allowed to participate in fertilizer importation and distribution following the issuance of the National Fertilizer Policy in 1993. A few importers and several wholesalers and retailers joined the market to provide an alternative private distribution channel. However, government in 1995 permitted the creation of regional holding companies with "strong ties" to regional governments (NFIA, 2001). It was quickly alleged that the government gave these holding companies preferential treatment in the allocation of foreign exchange for importation and in the distribution of fertilizer through government-administered credit to farmers under its large-scale New Extension Intervention Program (NEIP). By 1996, the NEIP accounted for 67% of all fertilizer distributed in the country, with the new holding companies being awarded virtually all of the program fertilizer supply contracts (Stepanek, 1999).

In 1996, under donor pressure to introduce transparency in the selection of fertilizer trading firms to supply the NEIP, the GOE instituted regional tender processes to award monopoly distribution rights to one firm in each district (Stepanek, 1999). However, Stepanek's careful documentation of this process through extensive field study in 1998 showed that in many cases there were no auctions, and that regional governments granted monopoly distribution rights to the holding companies in their respective region. Two large private companies, including Ethiopia Amalgamated (EAL) which has been a major fertilizer importer in Ethiopia since the 1960s, have exited the market because of an inability to acquire foreign exchange for fertilizer importation, a process that remains under the control of government. Regional governments have also aided the holding companies by providing government staff, storage facilities, and transport for their retailing operations (Stepanek, 1999). As of 2001, two regional holding companies and the fertilizer parastatal, AISE, account for 100% of fertilizer imports and local distribution.

Summary

Of the three countries examined, only Kenya provides a meaningful test of the private sector's response to reform. In Zambia, private trade in fertilizer was legalized, but the co-existence of government programs distributing fertilizer at subsidized prices and with high loan default rates clearly impeded incentives for private investment. In Ethiopia, government policy in recent years appears to have been designed to suppress competition and maintain control over fertilizer distribution (Stepanek, 1999; NFIA, 2001). Although all three countries ostensibly undertook a fertilizer market reform program, there were profound differences in implementation. The way in which the reforms were implemented in Zambia and Ethiopia make assessments of the private sector's response to reform in such countries virtually meaningless.

Fertilizer consumption trends in the post-reform period

The impact of fertilizer market reform on small-scale farmers could be better understood if fertilizer consumption data were disaggregated between the small-scale and large-scale/estate sectors, and between concessional vs. commercial sales. Few countries report data in such a disaggregated way. Based on information pieced together from government files and from fertilizer distributors, Govereh et al. (2002) were able to compile fertilizer use trends in Zambia by commercial private sector sales vs. government program sales (Table 2). Kenyan fertilizer use data from the Ministry of Agriculture is disaggregated between commercial and donor-financed imports, and by type of fertilizer. In Ethiopia, only total fertilizer use was available.

Fertilizer consumption has increased substantially in recent years in Kenya (Table 2). Data specific to the small-scale sector is unavailable. However, panel survey data on 1451 small-scale households covering 22 districts indicate a 16% increase in fertilizer consumption between the 1996/97 and 1999/00 seasons (Table 3). Much of the increase is due to increased consumption of top dressing fertilizer in specific parts of the main maize-producing areas of the country (North Rift Valley) and increased fertilizer use on sugarcane through outgrower arrangements. The total number of small-scale farms using fertilizer increased five percent, from 61 to 65 percent. Use rates vary considerably throughout the country, ranging from less than 10 percent of households surveyed in the drier lowland areas to over 90 percent in Central Province and the High-Potential Maize Zones in the North Rift.

In Zambia's case, overall fertilizer consumption has declined over the past decade (Table 2). Considerably fewer farmers apply fertilizer on maize in the northern part of the country since the withdrawal of maize transport subsidies conferred through the former parastatal marketing board's pan-territorial pricing structure. Smallholder cropping patterns in these regions have shifted dramatically from maize to crops such as cassava, groundnut, and cotton, which receive virtually no fertilizer in Zambia. While this decline has often been interpreted as demonstrating the failures of market reform, our analysis calls for a more nuanced perspective especially when considering implications for the design of future input marketing policy. First, because the fertilizer and maize subsidies were so large in the 1980s as to fuel hyperinflation and macroeconomic crisis, the former levels of fertilizer use in the 1980s were economically unsustainable, no matter what mix of private and public actors were to be involved in the sector. The state has scaled back its distribution of fertilizer on credit, although these programs still account for 60% of all fertilizer consumed by the small-scale sector. Second, it is misleading to evaluate the private sector's response to market liberalization without considering how the continuation of large-scale non-commercial distribution activities affects private traders' incentives. Zambian traders have complained about their commercial markets being undercut by the continuation of such programs (Govereh et al., 2002). Zambia's experience underscores the major challenge faced by many African ountries: how to achieve major increases in fertilizer use at the same time that

Table 2
Total fertilizer use trends, Zambia, Kenya, Ethiopia (Thousand metric tons)

Crop season	Zambia						Kenya			Ethiopia
	Local production (1)	Donor imports (2)	Private sector imports (3)	Govt imports (4)	Product handled by govt and agents (5) = (1) + (2) + (4)	Total supply[a] (6) = (3) + (5)	Commercial imports	Donor shipments	Total consumption	Total consumption
1981	24.0	16.0	0	141.0	181.0	181.0				31.1
1982	57.0	30.0	0	80.0	166.9	166.9	150.5	54.7	136.4	31.6
1983	90.3	113.0	0	9.3	212.6	212.6	188.2	25.1	142.8	45.1
1984	74.9	68.8	0	126.3	270.1	270.1	133.3	73.1	175.3	46.9
1985	16.7	30.4	0	0	47.1	47.1	199.6	145.6	238.1	24.1
1986	78.9	87.6	0	60.9	227.5	227.5	148.1	82.0	227.0	83.3
1987	66.2	96.0	0	85.1	247.4	247.4	82.9	142.3	238.0	121.3
1988	67.4	141.4	0	48.1	256.9	256.9	148.6	172.7	272.0	129.5
1989	35.9	28.2	0	245.4	309.6	309.6	74.0	111.5	237.0	129.4
1990	46.6	53.6	0	102.8	203.0	203.0	76.1	106.9	226.9	145.7
1991	34.3	18.0	0	134.3	186.6	186.6	169.9	74.1	253.6	147.0
1992	33.3	34.0	14.5	74.4	141.8	156.4	175.7	72.1	232.9	152.7
1993	27.1	113.7	88.0	16.1	157.0	245.0	166.0	107.0	286.5	107.5
1994	0	66.0	92.0	10.9	76.9	168.9		68.0	281.2	190.0
1995	0	25.4	69.0	35.7	61.1	130.1		34.2	295.6	246.7
1996	0	16.6	108.0	49.0	65.5	173.6		16.1	254.0	253.2
1997	0	0	96.9	0	15.0	96.9			255.0	220.4
1998	0.01	0	108.8	43.0	43.0	151.9			265.0	281.4
1999	10.2	0	134.3	23.9	35.0	144.5			358.6	290.3
2000									351.5	297.9
2001										279.6

Average: 1981-89	55.8	66.5	0	89.9	212.3	212.3	208.2	87.6
Average: 1990-95	23.6	51.8	43.9	62.4	137.7	181.7	262.7	182.8
Average: 1996-2001	2.6	4.2	112.0	29.0	39.6	141.7	296.8	274.0

Zambia sources: MAFF Statistical Bulletin 1998; Zambia Fertilizer Importers; and Faber 1993. Kenya sources: Ministry of Agriculture and Livestock Development. Ethiopia source: National Fertilizer Industry Agency.

[a] Some fertilizer imports to Zambia are re-exported to DRC and Malawi; year specified (Zambia) refers to first year of crop season, i.e., 1990 = 1990/91 season.

Table 3
Percent of crop area fertilized and dose rates (kgs/acre) by crop, 1996/97 and 1999/2000, among 1422 sample households in Kenya

Year	Maize		Wheat		Tea		Coffee		Sugar cane		Total
	% area	kgs/acre	% area	kgs/acre	% area	kgs/acre	% area	kgs/acre	% area	kgs/acre	% hhs using
1996/97	58.0	31.2	86.6	34.7	87.0	137.8	54.0	59.6	30.7	54.3	61
1999/00	60.3	36.5	96.0	34.0	98.0	110.6	53.3	115.1	53.3	73.1	65

Source: Tegemeo Institute/MSU Agricultural Monitoring and Policy Analysis Household Surveys, 1997 and 2000, Tegemeo Institute, Nairobi.

government's capacity to subsidize distribution to small-scale farmers is limited, and where such subsidies compete for scarce resources with other public investments such as roads, agricultural research, and extension that could reduce the costs of inputs and increase farmers' willingness to pay for them.

In Ethiopia, fertilizer use over the 1990s has increased dramatically (Table 2). The government has actively promoted fertilizer use through the NEIP, and donors have supported the growth in fertilizer use through highly concessional loans for fertilizer importation provided to the government (NFIA, 2001). Analysis by Howard et al. (1998) indicates that the NEIP technology package of improved maize seed, fertilizer, and management practices was highly profitable for most farmers in the three regions where farm budget information was analyzed. Loan recovery rates under the NEIP have been high, although NFIA (2001) indicates that the national government has required regional governments to pay for unrecovered loans, making it difficult to assess actual farm loan repayment. Yet it appears that by controlling input distribution, the state has limited farmers' options for acquiring fertilizer through alternative sources. This has mitigated the problem of input loan recovery that has plagued Zambia. In these respects, the concentrated market that government policy has promoted has encouraged greater use of fertilizer.

Potential for cost reductions in the fertilizer marketing systems and effects on profitability of fertilizer use on maize

Our conceptual framework disaggregates input marketing costs into four broad components: (1) transaction costs incurred in the coordination of exchange among market actors; (2) transformation costs such as transport, handling, and storage, and costs of facilitating functions such as financing and market intelligence; (3) costs from government behavior, including taxes and fees as well as state activities that impose additional costs on other actor's marketing activities; and (4) excess profits emanating from non-competitive behavior of marketing firms. An important question for agricultural policy is whether there are feasible institutional changes or public investments that could reduce fertilizer prices and make its use more

profitable to farmers. To address this question, we summarize findings from financial cost structures and farm budgets based on country-level studies. Financial cost structures are an accounting technique that adds all identifiable costs and margins at the various stages of the fertilizer supply chain, from the point of entry to the final consumer. The purpose is to understand the contribution of various types of costs to the farm-gate price of fertilizer, and to identify the potential to reduce these costs. Next, drawing from secondary data on partial budgets for maize production, sensitivity analysis was used to simulate how specific reductions in fertilizer marketing costs would affect gross margins for maize production, assuming that the cost reductions were passed through to farmers.

Financial cost structures

Financial cost structures were compiled for Kenya by Wanzala et al. (2002), Arwings-Kodhek (1996) and IFDC (2001); for Ethiopia by Stepanek (1999); for Zambia by Govereh et al. (2002); and for Malawi by Westlake (1999).[5] These cost structures are synthesized into aggregated cost categories in Table 4. Several observations emerge from this marketing cost decomposition.

First, the C.I.F. price of fertilizer at the port of entry is roughly half of the farm-gate price in Kenya and Ethiopia, and less than half in landlocked Malawi and Zambia. Domestic marketing costs typically account for $200 per ton or more of the farm-gate price. Domestic marketing costs appear to be lower in Ethiopia, but this is at least partially because various retailing functions were absorbed by the government and not reflected in traders' cost structure (Stepanek, 1999).

Second, costs of roughly $30–$50 per ton are incurred between unloading the fertilizer off the ship and loading it on trucks ready for inland transportation. These costs include port handling and clearing fees, bagging the fertilizer, the costs of the bags, local storage at the ports (which often is necessary because onward transportation cannot be timed to coincide with when the fertilizer has been cleared from the port), and government fees. Additional port charges, not reflected in Table 4, arise if port authority stevedoring crews are temporarily unavailable, causing delays in offloading fertilizer from the ship and associated demurrage charges. Bulk buying and transportation, while capable of reducing per unit shipping costs, can be more costly if the ports cannot handle the type of vessel or if special off-loading equipment is needed. Beig (2002) noted that about a third of Mombasa port's berths were inoperable at the time of inspection because of repairs needed to key equipment.

Third, transportation, handling, transit losses, and storage costs borne by wholesalers and retailers accounted for over $100 per ton in Kenya and Zambia, and between $80–$100 per ton in Malawi and Ethiopia. Kenyan retailers' transit losses averaged about three times greater per unit shipped than for importers and large wholesalers. Transit loss costs are passed on to farmers, amounting to 3–5% of the farm-gate price in the Kenyan supply chains analyzed by Wanzala et al. (2002).

[5] Because of space limitations, the reader is referred to these studies for details on methods and data.

Table 4
Financial price structures for fertilizer delivered to the farm-gate, various countries (US $ per metric ton)

	(1) Kenya, 1995, DAP	(2) Kenya 1999, DAP*	(3) Kenya 1999, DAP*	(4) Kenya 1999, DAP*	(5) Kenya 1999, DAP*	(6) Kenya 2000, DAP	(7) Zambia 1999/00, Urea	(8) Malawi 1998/99, Urea	(9) Ethiopia 1998, DAP	(10) Ethiopia 1998, Urea
C.I.F. Port[a]	313.10	232.29	232.29	335.43	232.29	199.65	133.3	126.50	251.95	125.00
Govt. taxes	8.03	9.14	9.14	13.43	9.14	5.89	2.00	2.94	—	—
Port handling, stevedoring, cleaning fees	8.86	14.86	14.86	15.83	14.86	21.76	5.50	8.50	13.79	12.57
Bags/bagging[d]	13.00	10.86	10.86	10.86	10.86	7.00	17.00	21.00	4.55	4.55
Local storage at port and associated handling/transport	5.73	10.57	10.57	15.71	10.57	8.38	3.00	1.50	1.26	0.74
FOT, Ex Port[f]	350.00	277.71	277.71	380.86	277.71	244.94	160.80	160.44	282.65	173.17
Ex Port Marketing Costs:										
Transport/handling/storage/transit losses[g]	na	110.86	104.00	123.71	135.14	108.52	166.50	82.60	87.27	99.91
Financing / capital costs[h]	na	43.71	28.29	25.43	43.43	6.99	12.90	41.89	14.17	7.03
Importer/wholesale/retail mark-up[i]	na	33.43	55.71	54.29	95.14	35.88	27.80	113.93	5.80	5.80
Farm Gate Price[j]	na	465.71	465.71	594.29	551.43	396.33	368.00	398.86	377.24	242.91
Total Domestic Marketing Costs[k]		233.42	233.42	258.86	319.14	196.68	234.7	272.36	125.29	117.91
(as % of farm-gate price)		(50.1)	(50.1)	(43.6)	(57.9)	(49.6)	(63.8)	(68.3)	(33.2)	(48.5)

Sources: Arwings-Kodhek, 1996 (column 1); Wanzala et al., 2002 (columns 2–5); IFDC, 2001 (column 6); Govereh et al., 2002 (column 7); Westlake, 1999 (column 8); Stepanek, 1999 (columns 9 and 10).

Notes: (a) cost, insurance, freight before off-loading at the port; (d) costs of bags estimated at $0.35 where not provided. (f) free on truck ex port; these costs do not necessarily equal C.I.F. port plus port clearing costs because of finance charges and importer margins, which are accounted for on lines (h) and (i). (g) includes $20 per ton retail-to-farm transport costs; (i) derived as farm-gate price—C.I.F. port price—all observed costs. Ethiopia's mark-up margins are low because of the structure of Ethiopia's fertilizer marketing system in 1998, some retail functions were handled by government and not included in the financial cost of fertilizer. Once transported to the district town, the only cost that is accounted for in the Ethiopia budgets are "unloading into a store." Costs incurred at retail level in other budgets include transit losses, storage costs (rent, labor, security), re-bagging, capital costs, and retail mark-up margins. (k) defined as farm-gate price minus C.I.F. port price.

*Columns (2)–(5) represent a range of marketing channels to Western Kenya observed at different points in time in 1999 (see Wanzala et al., 2002 for details).

These costs also include an imputed $20 per ton charge borne by farmers to transport their fertilizer from retail shops to their farms, based on survey findings. Because Kenya has a relatively dense fertilizer retailing network and relatively good road infrastructure, the transport costs borne by farmers in other countries are, on average, likely to be greater.

Fourth, the sum of imputed net profit margins for importers, wholesalers, and retailers (returns to management and unaccounted-for costs) were in most cases 10% or less of the total farm gate price in Kenya, Zambia, and Ethiopia. This corroborates findings by IFDC (2001) for Kenya and Uganda, and by Omamo (2002), who found net margins in the range of 2–5% for fertilizer traders in Uganda. The Ethiopia results should be interpreted differently because some of the retailing functions were carried out by government rather than the firm awarded the right to distribute fertilizer (Stepanek, 1999). Westlake's computations for Malawi in 1998 show an exception here; the sum of importer, wholesaler, and retailer margins was $114 per ton (28 percent of the farm-gate price). Westlake attributes this partially to the devaluation of the Malawi kwacha, and uncertain demand due to subsidized government distribution programs similar to those in Zambia.

The way forward: opportunities to reduce marketing costs

There appears to be substantial scope to reduce fertilizer marketing costs in each of the three countries analyzed. Because of space limitations, we highlight several important sources of potential cost reduction here, and refer the reader to the more detailed analyses in Wanzala et al. (2002); Govereh et al. (2002); and Stepanek (1999).

Policies to coordinate port clearing with inland transport. Problems in coordinating the clearing of fertilizer from the port with the availability of domestic inland transportation introduced extra marketing costs in both Ethiopia and Kenya. All traders surveyed in Kenya indicated that they could not transport their fertilizer directly up-country from the port of Mombasa because of problems in securing transport at the time the fertilizer was cleared from the port. Rules prohibit all but two transport companies from operating at the port, thereby forcing most traders to store their fertilizer in local warehouses near the port before arranging for road transport for subsequent movement up-country. This extra stage involved an additional $8–$15 per ton in transport and handling costs. The Kenya Port Authority (KPA) also stipulates that stevedoring and loading onto vehicles at the port can only be carried out by KPA employees at KPA rates. By imposing extra storage, handling, and transport costs on traders, these regulations inflate marketing costs that are ultimately passed on to farmers. Stepanek documents similar coordination problems between the offloading of fertilizer at Assab and Djibouti ports and the timing of inland tranport to Ethiopia, although in this case, the extra storage and handling costs were only 2% of the retail price.

Facilitating the transparency of government programs. The Zambia and Ethiopia studies identified "double-handling" of fertilizer, in which traders shipped, unloaded and stored fertilizer at central warehouses and waited to see where government

programs distributing subsidized fertilizer would be operating, after which they transport the fertilizer to areas where their commercial operations would not be affected. Zambian traders stated that costs could be avoided by shipping their stocks directly from South African ports to regional markets in Zambia, and turning over the stock as quickly as possible, but this strategy was too risky until the volume and location of government programs was known. Costs arising from the "double-handling" problem were estimated at $25–$42 per ton (7–11% of the cost to farmers). Ethiopian trader surveys also indicated that additional storage and handling costs were incurred because of delays in determining the location of government distribution programs. The additional costs of unloading, storage at central warehouses, reloading, and interest charges were found to be roughly 4.5% of the retail price for both DAP and urea.

Reassess levies on fertilizer and transportation. Levies incurred at the port of Mombasa accounted for 2–3% of the farm-gate price. While levies are important for financing the cost of state activities, levies on fertilizer are passed along through the marketing system and ultimately borne by farmers, which may run counter to other important national objectives such as smallholder income growth and food security. Wanzala et al. (2002) found that the elimination of these levies would raise smallholder profits per bag of maize produced by 3–12%, depending on location and intensity of fertilizer application. Also, consideration should be given to reducing the 45% and 100% diesel fuel taxes in Zambia and Kenya that raise the costs of exchange not just for fertilizer but on commerce in general.

Policies affecting market structure and competition. Using a hedonic pricing model applied to 1998 transaction data on the price of fertilizer delivered to retail centers in Ethiopia, Stepanek (1999) found that farmers paid 4% and 13% higher prices for DAP and urea, other factors constant, when the district administration appointed a fertilizer supplier for its government programs instead of implementing a competitive tender process as was done in some districts. Donors urged the government to arrange competitive tenders for awarding fertilizer supply contracts to traders, but this was implemented in a minority of areas surveyed. Private dealers have withdrawn from the fertilizer market in recent years, allegedly due to regulations favoring government-affiliated companies and the parastatal AISE.

Investments in transportation infrastructure. Domestic transport costs per kilometer increase greatly toward the end of the supply chain as fertilizer is transported in smaller units along generally poorer-quality roads. Wanzala found that fertilizer was often transported by retail bicycle transporters 15 kms from retail shops to villages, and these costs typically accounted for $20 or more per ton, about the same as the international shipping costs from international suppliers to the ports. Efforts to improve rural road infrastructure and transport systems could have high payoffs not only for the economics of fertilizer use, but for economic activity in general.

Potential effects of banking and foreign exchange system performance on fertilizer prices. Wanzala's financial price structure in column 5 of Table 4 provides an interesting example of how unforeseen risks may affect the profits of fertilizer traders and prices borne by farmers. Note that the trading margins in column 5 are sub-

stantially higher than those computed in the other four Kenyan examples. In the area and time during which the data for this scenario was computed, two major importers were unable to import fertilizer because their local bank had a temporary liquidity problem, and as a result the international bank refused to guarantee their letters of credit. Wholesalers that had arranged to be supplied by these importers were therefore temporarily unable to secure fertilizer to distribution in their areas. This created a localized shortage of fertilizer in their distribution areas which another major importer attempted to fill by ordering another consignment which began to arrive and be distributed in March/April. However, in the interim, local supplies were constrained and prices reached unprecedented levels of up to US$570 per ton in March 1999.

This section indicates that there is considerable scope to reduce fertilizer marketing costs in the three countries analyzed. Much of this potential is in the area of transportation and handling costs, although the catalysts for reducing these costs are varied and include changes in regulations that inhibit better coordination between stages in the marketing system, the design of government programs, and investing in public goods.

Potential payoffs to fertilizer cost reduction: Sensitivity of crop production costs to fertilizer prices

The three country case studies indicate that fertilizer marketing costs are inflated by numerous factors, many related to weak infrastructure, policy and regulatory barriers, and lack of coordination within the fertilizer supply chain. Individually, these problems generally add marginally to the ultimate cost of fertilizer borne by farmers, but their cumulative effect is often substantial. Stepanek estimates that if the three most important regulatory and coordination problems described above for Ethiopia could be redressed, farm-gate prices of DAP and urea in the areas analyzed could decline by 15–18%. Wanzala et al. determined that the three most important sources of cost reduction amounted to roughly 11% of the farm-gate price of DAP in Western Kenya. These studies did not measure the cost or political feasibility of achieving these cost reductions. Yet they help to explain why fertilizer marketing costs are substantially higher in SSA than elsewhere, and the magnitude of cost reduction that might be possible through selected public investments and regulatory changes in the fertilizer marketing system.

Using Kenya as an example, Table 5 indicates how capturing these sources of fertilizer cost reduction would affect the profitability of maize production by smallholder farmers. The simulations assume that cost reduction in the supply chain is passed along to farmers. Results are also sensitive to the intensity of fertilizer use and to response rates of maize to fertilizer application. The results, reported in Wanzala et al., are derived from maize budgets in three maize-producing areas of Western Kenya. Application rates of 75 kg of DAP/acre and 100 kg of CAN/acre, which represents a relatively high-input and management-intensive production system, are used. In these areas, roughly 30% of farmers applied fertilizer on maize at

Table 5
Simulated changes in maize profitability from illustrative reductions in fertilizer marketing costs, Bungoma, Lugari, and Trans Nzoia districts, 1999

Scenario	Profit measure	Bungoma	Lugari	Trans Nzoia
Base Case (current conditions at time of survey, 1999)	Fertilizer costs as % of total production costs per acre:	29.7	27.6	17.4
	Production cost per acre (Ksh):	11,607	13,567	19,870
	Profit per 90 kg bag maize (Ksh):	135	202	305
Scenario 1: Remove Mombasa Port fees[a]	Production cost per acre (Ksh):	11,383	13,343	19,646
	Profit per 90 kg bag maize (Ksh):	151	215	314
	% increase profit/bag maize (relative to Base Case):	+11.9	+ 6.4	+ 3.0
Scenario 2: Port-to-up- country transport coordination, obviating need for transport to warehouse and port storage[b]	Production cost per acre (Ksh):	11,415	13,374	19,678
	Profit per 90 kg bag maize (Ksh):	148	213	313
	% increase profit/bag maize (relative to base case):	+10.4	+ 5.4	+ 2.6
Scenario 3: 20% transportation cost reduction from improved infrastructure and reduce transportation rates[c]	Production cost per acre (Ksh):	11,408	13,367	19,671
	Profit per 90 kg bag maize (Ksh):	149	214	313
	% increase profit/bag maize (relative to base case):	+10.5	+5.4	+2.6
Scenario 4: combined effects of scenarios 1, 2, and 3[d]	Production cost per acre (Ksh):	10,991	12,951	19,080
	Profit per 90 kg bag maize (Ksh):	179	238	337
	% increase profit/bag maize (relative to base case):	+32.6	+17.8	+10.5

[a] This will result in a reduction of Ksh 64 per 50 kg bag of DAP.
[b] This will result in a cost reduction of Ksh 55 per 50 kg bag of DAP.
[c] This will result in a cost reduction of Ksh 57 per 50 kg bag of DAP.
[d] This will result in an accumulated cost reduction of Ksh 176 per 50 kg bag of DAP.

these levels. The profitability of maize production will be less sensitive to fertilizer price reductions for most small-scale farmers in Kenya.

For these relatively intensive maize production systems, however, the impact of fertilizer price changes on costs of production and profitability are quite large. Under Scenario 1, which reflects the abolition of Mombasa port fees, the profit per bag of maize increases 11.9% in Bungoma, 6.4% in Lugari, and 3.0% in Trans Nzoia. Maize profitability is more sensitive to the price of fertilizer in Bungoma because under recommended application rates, they form a higher proportion of total production costs compared to the other districts. While the removal of port taxes would not appreciably affect maize profitability per bag in areas with intensive use of other cash inputs and high agronomic response rates to fertilizer application, such as Trans Nzoia, they appear to have a significant effect on the profitability of maize production in medium-potential areas such as eastern Bungoma, other factors constant. The impact on profitability of Scenarios 2 and 3 are comparable to those of Scenario 1.

Over the long run, it may be possible to capture the combined benefits of several scenarios. As shown in the last row of Table 5, the combined effects of the three scenarios are very dramatic. Using recommended rates of DAP and CAN in Bungoma, the profit per bag of maize produced increases by 32%, while in Lugari and Trans Nzoia, profits per bag increase by 17.8% and 10.5%, respectively.

These simulation results are likely to underestimate the actual increase in the profitability of using fertilizer on maize, since the simulations are based simply on benefits from lower fertilizer prices, holding application rates constant. In practice, farmers are likely to respond to lower fertilizer prices by increasing the quantity applied to maize, other factors constant.

Conclusions

This article highlights the need to carefully understand the specifics of marketing policy reform implementation to meaningfully evaluate its effects. ''Reform'' is not monolithic in its design, nor has it been implemented in a uniform fashion across countries. Therefore, one cannot meaningfully speak of market reform either ''working'' or ''failing''. Effects depend on the specifics of reform design and implementation. A comparison of Kenya, Ethiopia, and Zambia is informative in this regard. These countries have pursued very different paths to reform design and implementation, with very different outcomes. Only in Kenya was fertilizer market reform implemented in a way that allows a meaningful assessment of the private sector's response to reform. In Zambia and Ethiopia, no valid assessments can be made because these countries chose a set of policies that impeded rather than supported competitive trader entry and investment.

In Kenya, the state has withdrawn completely from direct fertilizer distribution and pricing. Smallholder farmers are supplied almost exclusively from commercial trading companies. These firms range from large vertically integrated firms to small diversified traders to cooperatives and outgrower companies, and in the case of tea,

a commercially oriented parastatal. There has been substantial private sector response to reform since 1993. As of 1999, 22 firms imported fertilizer, and there were roughly 500 wholesalers and over 7000 retailers. Overall fertilizer consumption in Kenya has increased from a mean of 208,000 tons in the 1980s, to 263,000 tons in the 1990–95 period, to nearly 300,000 tons in the 1996–2001 period. Survey data indicate that smallholders have increased their use of fertilizer since 1996/97, mostly on sugar, horticulture, wheat, and maize in specific areas. The use of fertilizer by small-scale farmers is among the highest in Africa, although much greater use will be required to catalyze rural productivity growth. Fertilizer consumption is still limited, especially on cereal crops, in areas where agro-ecological conditions create greater risks and lower returns to fertilizer use. Internal marketing margins have declined in the past decade, although there still appears to be substantial room for further cost reduction.

Zambia's experience with fertilizer market reform has been less encouraging. Fertilizer use by smallholder farmers has declined precipitously since the 1980s, when both fertilizer and maize production in the more remote regions were heavily subsidized. The private sector's response to market reform has been limited. However, Zambia has not actually implemented many of the key reform measures that donors have been advocating since the late 1980s. The continuation of large-scale government programs offering subsidized fertilizer on credit has seriously undermined the incentives of private traders to invest in the system. These programs have raised the risks and marketing costs of private traders' commercial operations. Moreover, liberalization as implemented in Zambia has not been supported by complementary investments in public goods such as transport infrastructure, seed research to generate new varieties more responsive to fertilizer application, and demonstrations and extension information on appropriate levels of fertilizer use in different regions (Govereh et al., 2002).[6]

Ethiopia's fertilizer market reform process has resulted in greater government control over pricing and distribution and the exit of longstanding private actors from the market. Fertilizer consumption has increased dramatically in the past 10 years, and the government's campaign of distributing fertilizer and improved seed on credit has succeeded in intensifying crop production. Certain stages of the distribution channel appear to be covered by regional or national treasuries (NFIA, 2001). Because donors have assisted the government's financing of fertilizer importation through aid assistance programs, it is not clear whether the system will be able to maintain current levels of use if donor support is withdrawn (NFIA, 2001).

The paper has also highlighted an economic condition necessary for fertilizer markets to develop, i.e., that the costs of supplying the input must be lower than farmers' willingness to pay for it. Where this economic condition is unlikely to exist, we question the applicability of the "market failure" terminology and certain normative policy implications associated with it. While the term is rarely defined,

[6] The government advises application of 200 kgs of basal and 200 kgs of top dressing fertilizer per hectare throughout the entire country.

its use in relation to fertilizer markets in Africa tends not to be based on empirical evidence of a violation of market efficiency conditions, but rather reflects a dissatisfaction with the allocative process of markets. Markets seldom arise in areas where the costs of supplying the input exceed the willingness to pay for it. However, this outcome is often in conflict with the achievement of agricultural policy and other broader social goals. While non-commercial distribution programs can stimulate fertilizer use by subsidizing its price in areas where effective demand would otherwise be limited, appropriate policy choices should be based on a comprehensive consideration of the opportunity costs of alternative uses of the treasury outlays (e.g., might the same resources, if used differently, produce even greater impacts on social goals?). While input subsidies and credit targeted to farmers with little effective demand have great potential in theory to stimulate agricultural productivity growth *if the input is truly economically profitable,* there are two major reasons why actual benefits are likely to fall short of theoretical benefits. First, most governments with weak organizational capacities cannot implement effective targeting programs (Gladwin et al., 2002), and second, it is difficult even in so-called developed countries to shield well-intended social programs from being subverted into vehicles for rent seeking and clientelism (van de Walle, 2001).

Fundamentally, and regardless of which type of marketing actor is chosen to do the job, substantially increased fertilizer use in Africa will require coming to grips with the need to reduce the high physical costs of exchange that impede marketing activities by all agents, whether they be private, parastatal, or cooperative. This conclusion follows from decomposing the costs incurred in marketing of fertilizer through financial cost accounting techniques. In each of the three countries analyzed in this article, transport and handling costs accounted for 50% or more of total domestic marketing margins. The sum of importer, wholesaler and retailer profit margins generally account for less than 10%.

Notwithstanding the necessity of developing coordination arrangements for reducing transaction costs as part of a comprehensive approach to market development, we also stress the need to maintain adequate focus on reducing transformation costs of marketing as well. Our analysis indicates that domestic marketing costs can be reduced through the following: reducing port fees, coordinating the timing of fertilizer clearance from the port with up-country transport, reducing transport costs through port, rail, and road improvements, reducing taxes on fuel, and reducing the uncertainty associated with government input distribution programs that impose additional marketing costs on traders. Estimated reductions in the farm-gate price of fertilizer from implementing the full range of options identified in each country range from 11 to 18%.

Capturing these benefits will require revitalizing the public sector's role in providing key public goods to raise farmers' effective demand for fertilizer and reduce the physical costs of supplying it. This will need to be an incremental approach—resources are not available to do everything at once. Cost-benefit analyses taking into account externalities should guide the process of incremental investments. Also, despite the initiation of input marketing policy changes, policy barriers still impose major costs on traders in some countries. Some aspects of government

behavior, as in Ethiopia and Zambia, effectively drive some firms' marketing costs to infinity. Policy analysis needs to approach the issue of reducing marketing costs from a comprehensive perspective, recognizing the importance of strengthening and developing new institutions, investing in public goods, and overcoming policy-related barriers to improved market performance.

A forward-looking approach to input market development also requires attention to raising farmers' willingness to pay for fertilizer. Raising farmers' willingness to pay for fertilizer involves public sector support for agricultural research systems, the generation of seed technologies more responsive to fertilizer application, the establishment and dissemination of appropriate input recommendation domains (as opposed to one blanket recommendation for an entire country), viable systems for financing farmer input needs, market information, effective institutions for contract enforcement, and public investments in infrastructure and telecommunications to attract new investments by commodity marketing firms. These "public goods" investments, often considered outside the scope of fertilizer marketing policy, nevertheless strongly affect the demand for fertilizer and hence whether markets for fertilizer can arise.

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