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The Supply of Inorganic Fertilizers to Smallholder Farmers in Uganda

Evidence for Fertilizer Policy Development

Todd Benson

Patrick Lubega

Stephen Bayite-Kasule

Tewodaj Mogues

Julian Nyachwo

Development Strategy and Governance Division

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

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AUTHORS

Todd Benson, International Food Policy Research Institute
Senior Research Fellow, Development Strategy and Governance Division
T.Benson@cgiar.org

Patrick Lubega, International Food Policy Research Institute
Senior Research Assistant, Development Strategy and Governance Division

Stephen Bayite-Kasule, Embassy of the Netherlands, Kampala
Policy Officer, Agribusiness and Economic Diplomacy

Tewodaj Mogues, International Food Policy Research Institute
Research Fellow, Development Strategy and Governance Division

Julian Nyachwo, AT-Uganda
Technical Advisor, Agribusiness/Fertilizer

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ABSTRACT

Inorganic fertilizer is one of a handful of agricultural technologies that has immense potential for raising the productivity of poor smallholder farmers, enabling them to increase income, accumulate assets, and set themselves economically on a pathway out of poverty. The very low prevalence of fertilizer use by Ugandan farmers—well below 5 percent—is evidence that farmers find it difficult to access fertilizers for their crops at a price that will allow them to obtain sufficient and reliable returns from their investment in fertilizer.

This paper presents the results of a broad study of fertilizer supply to smallholder farmers in Uganda that was done to assess whether the taxes (explicit or implicit) that are applied at various points along the fertilizer importation and marketing chain or the absence of key public goods and services reduce the access that smallholder farmers have to fertilizer. The study involved a review of the literature of fertilizer supply, demand, and use; interviews with key participants in fertilizer importation and marketing in Uganda; and two surveys—one with farmers and the other with input suppliers—in four farming areas where fertilizer is used more than is the norm for the country as a whole.

Our broad finding is that the government of Uganda has taken several actions that have been conducive to improving farmer access to fertilizer. Over the past 10 to 15 years, fertilizer importers and traders have seen a growing market for inorganic fertilizers. Moreover, the relatively small margins that fertilizer traders obtain provide some evidence that a generally competitive market for the supply of fertilizers is now in place within Uganda. However, in some areas government inaction is having an adverse effect on efforts to increase use of fertilizer. The most important of these missing public goods are not specific to fertilizer but are implicated in broad efforts for increased economic growth in Uganda. However, the government of Uganda should undertake several fertilizer-specific initiatives to enhance farmer uptake:

- Overcome information constraints.
  - for fertilizer traders—on the regulatory regime within which they must operate
  - for smallholder farmers—on the proper agronomic use of fertilizer on specific crops under specific agroecological conditions, and on the proper economic use of fertilizer under changing input and output market conditions so that they can derive reliable profits from their use of the technology
- Reform regulations. A considerably lighter regulatory regime than what is now in place would allow more fertilizer into Uganda, resulting in lower costs for farmers.
- Exercise a cautious attitude toward undertaking direct interventions to promote increased fertilizer use by Ugandan smallholder farmers. Strengthening agricultural output markets is as important in this regard as undertaking fertilizer-specific initiatives.

Keywords: fertilizer supply, agricultural input policy, Uganda

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1. INTRODUCTION

Most of the poor in Uganda, as throughout African south of the Sahara, are members of rural farming households. To escape poverty in a sustainable manner, households must begin a process of savings and accumulation of productive assets whereby, based on the returns in income over time to those assets, they are able to establish a pattern of continual improvement in their welfare and move out of poverty. A key factor that enables smallholder-farming households to enter into this beneficial pattern of household economic growth is enhanced agricultural productivity to increase the economic returns that they enjoy from their agricultural assets. Without improving the productivity of the assets that they possess, households are unable to save and accumulate, produce little, are unable to invest in additional assets to increase the scale of their household economic production; therefore they remain in poverty, stuck in what is often termed a poverty trap (Carter and Barrett 2006).

Where insufficient plant nutrients in the farming system are limiting production, inorganic fertilizer is a technology that can be used at all scales of agricultural production—from the small vegetable plot to large plantations—to enhance production. As such, fertilizer is one of a handful of agricultural technologies that has immense potential for raising the productivity of poor smallholders, enabling them to increase income, accumulate assets, and set themselves economically on a pathway out of poverty. However, poor farmers face important cash constraints within a context of limited credit availability. The poorest generally are unable to save sufficient cash from one cropping season to the next to enable them to purchase fertilizer. Over the past 50 years, overcoming these constraints to access of fertilizer by smallholders has received considerable attention by policy researchers and governments through a range of interventions.

This study is in line with these past efforts: Our focus is on identifying which aspects of the Ugandan government's policies on fertilizer importation and marketing may increase the farmgate cost that smallholder farmers pay for fertilizer and, thereby, inhibit their profitable use of the input. The policies of interest include any duties, taxes, fees, or other charges that are levied on the fertilizer importation and marketing chain actors—costs that these actors will then pass on to the end user, the smallholder farmer.

However, in addition to these direct additional costs, this study considers areas in which the government may not have sufficiently invested in public goods to facilitate farmers' access to fertilizer. These inadequate or missing public goods might include, first, insufficient and costly transport infrastructure. Second, provision of information related to fertilizer may be poor or inadequate, including information on fertilizer markets and technical agricultural information for farmers seeking to maximize the efficiency with which they use the costly input on crops on their farm in order to derive maximum profits. And third, the government may have invested too little in developing institutions involved in promoting fertilizer use or regulating fertilizer trade.

The economics of fertilizer use by Ugandan smallholder farmers is clearly problematic. The very low prevalence of fertilizer use by smallholders—well below 5 percent of farmers in Uganda regularly use the input—is clear evidence that farmers find it very difficult to access the correct inorganic fertilizers for their particular crops at a price that will allow them to obtain sufficient and reliable returns from their investment in fertilizer. Several reasons for this are as follows:

- The input is costly, being a bulky commodity produced overseas and shipped inland from Mombasa, in neighboring Kenya, principally by expensive road transport.
- Information for farmers as to how they can make most efficient and profitable use of fertilizer is limited. Understanding of yield response patterns is limited regarding the application of inorganic fertilizer for the major crops of Uganda, and the little knowledge that does exist is not communicated in a manner that can be understood easily by farmers or by agricultural advisory services staff.

- Inadequate or costly credit markets and significant household cash constraints present added barriers to fertilizer use by smallholder farmers. The deficiencies in Ugandan credit markets also make it difficult for fertilizer suppliers and traders to efficiently supply fertilizer at low cost.
- On the crop output side, fertilizer use has substantial risks. Farmers may not obtain the returns in crop yields or revenues from crop sales necessary to pay for the fertilizer used.
    - Rainfed, low-input agriculture is inherently risky. Although the important cropping areas of Uganda have among the highest levels of potential productivity in Africa south of the Sahara and have quite reliable rains with infrequent crop failure, variability in seasonal rainfall amounts or temporal distribution is an added source of risk to the use of fertilizer. Moreover, pest and disease pressures on crops are higher in Uganda, particularly in the bimodal rainfall areas of the country, than in many other African countries with smallholder farming systems.
    - An important service that would alleviate the detrimental economic impact to farmers of such production risk is nearly absent in Uganda: crop insurance markets. Market failures exist in the form of asymmetric information between farmers and insurers, as it is difficult or impossible for insurers to discern how much of a yield loss is due to exogenous circumstances such as rainfall versus behavioral changes by a farmer due to moral hazard effects of the insurance. Information problems also induce adverse selection problems, when insuring agents have to set premiums at high levels due to their inability to differentiate between farmers exposed to low risk and to those exposed to high risk. Therefore, crop insurance is severely undersupplied by private insurers, and to date, the public sector has also not been able to correct such market failures and enable well-functioning crop insurance provision to farmers seeking to cope with risk.
    - Another source of risk is volatile output markets. For staple foods in Uganda, cycles of crop surpluses and deficits commonly follow crop price booms and busts, respectively. Uncertain crop prices make it difficult for farmers who use fertilizer to be confident that they will obtain a sufficient return from the sale of the additional harvest via the use of fertilizer to pay for the input. Many of the staple food crops grown in Uganda are not extensively traded in regional markets. As a consequence, local crop production conditions that affect supply principally determine the prices that farmers receive.
- Finally, while many rural areas of Uganda are densely populated, the country as a whole still has uncultivated arable land, particularly in north central Uganda. Therefore, opening new land to cultivation to produce more crops is generally less costly for Ugandan farmers than investing in yield-enhancing technologies, like fertilizer, on existing cultivated land. In those areas of Uganda where uncultivated arable land is not available to bring into production, the output prices for crops that are traded in local markets nonetheless will be determined in part, due to market integration, by the lower costs of production in the land-surplus areas.[1] The lower output prices that result as a consequence render profitable use of fertilizer on crops more difficult for smallholders to achieve.

It is within this challenging economic context of fertilizer use by smallholder farmers that our study is situated. Our focus is on private-sector procurement of fertilizer for wholesale or retail trade and on ways that farmers then access that fertilizer offered by traders.

[1] This relationship will not apply to internationally traded cash crops, as their prices are determined in the international market and not in Ugandan or regional markets.

Problem Statement, Design, and Organization of the Study

The Ugandan government's policies on fertilizer importation and marketing can either promote or inhibit the profitable use of fertilizer by smallholder farmers. Where policies are shown to increase the farmgate price for fertilizer, a close assessment should be made of the social value of such policies. This paper presents the results of a broad study of fertilizer supply to smallholder farmers in Uganda, to assess whether the taxes (explicit or implicit) that are applied at various points along the fertilizer importation and marketing chain and whether the absence of key public goods and services inhibit the efficiency with which those chains operate and reduce the access that smallholder farmers have to inorganic fertilizer. The evidence offered by this study will support efforts by the Ugandan government to streamline its engagement in fertilizer importation and marketing chains to improve the profitability of fertilizer use by smallholder farmers.

The overall objective of the study is to investigate supply-side constraints for fertilizer use by smallholder famers in Uganda in which the government is implicated. However, this objective is met in an indirect manner by taking a broader look at how fertilizer is supplied to smallholder farmers and how they do or do not make use of it. So, while the objective is to determine what policy changes might reduce fertilizer costs for farmers, the identification of these policy changes is undertaken through a broad assessment of how the input is supplied. Inefficiencies in activities related to supply and information deficiencies will be identified, as will regulations on fertilizer supply that are poorly designed for accomplishing their intent.

The principal data-collection activities used for undertaking this study were as follows:

- First, quite an extensive review of the literature on fertilizer supply, demand, and use in Uganda was undertaken. Over the past 20 years, a series of research efforts has centered on the issue of how fertilizer availability and access might be improved for smallholder farmers in Uganda. The reports and other documentation from these efforts were reviewed. Close consideration is also made of the implications of trade regulations for the import of inorganic fertilizers in Uganda.
- About two dozen interviews were conducted with key participants in fertilizer importation and marketing in Uganda, primarily in Kampala, but also in Malaba and Busia, the two principal border crossings from Kenya.
- Finally, two surveys were conducted—a trader survey and a farmer survey—in four farming areas of Uganda where more fertilizer is used by smallholders than is the norm for the country as a whole: Masaka, where fertilizer is used on maize and Robusta coffee; peri-urban Kampala, where fertilizer is used primarily on vegetables; the maize area around Iganga; and the western slopes of Mount Elgon (Mbale, Sironko, and Kapchorwa districts), where fertilizer is used on maize and Arabica coffee. (See Figure 4.1 for a map of the locations of the study areas.)
    - In the trader survey, 70 traders based in market centers in the study areas were interviewed using a questionnaire containing about 210 questions. The sample of traders was randomly selected from a 2008 census listing of agro-input dealers in Uganda. Both large- and small-scale traders were interviewed. However, as the sampling frame used contained no information on scale of operation, this factor was not used in selecting the sample of traders but became apparent only upon analysis of the data.
    - In the farmer survey, a questionnaire of about 230 questions was administered to a sample of 275 smallholder farmers in the farming areas of the study, both users and nonusers of fertilizer, which focused on their cropping practices and, for users, how they acquired and made use of fertilizer.

The presentation in this paper draws upon these data sources in a somewhat sequential fashion. The following section provides an overview of fertilizer use in Uganda and how it has evolved over the past 15 years, drawing from the literature review. Following this overview, the information collected

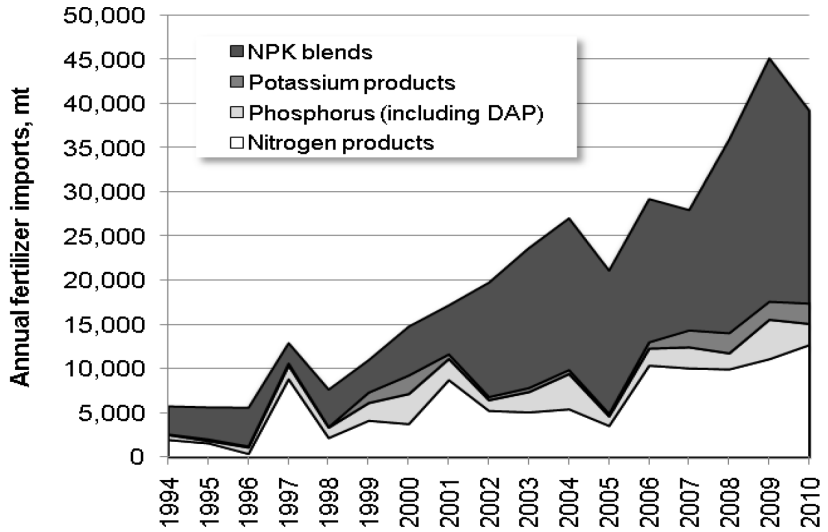
through the interviews of key participants in the fertilizer importation, distribution, and marketing chain in Uganda is used to more closely describe how fertilizer is brought into the country and made available to farmers. The results from the trader survey are then discussed in some detail, followed by a similar discussion of the results of the farmer survey. The final section reviews some of the key policy and market issues emerging from the study.

Finally, it should be highlighted that considerable fertilizer is used in Uganda by large-scale agricultural plantations or through the contract farming systems that some of these large-scale agricultural firms manage— most notably, tea, sugarcane, and tobacco. These firms generally import their fertilizer stocks directly or through tenders let to fertilizer importers and do not participate greatly in the fertilizer distribution and marketing chains serving smallholder farmers. However, this study does not pay much attention to this important component of fertilizer supply and use in Uganda, focusing rather on the supply of fertilizer to smallholder farmers.

2. OVERVIEW OF FERTILIZER SUPPLY AND USE IN UGANDA

Although Uganda produced phosphate fertilizers in the past, currently all of the inorganic fertilizer used in the country is imported. (A brief discussion on the potential for domestic production of inorganic fertilizer is found in the appendix.) The annual total fertilizer imports by product weight for both commercial agricultural enterprises and smallholders as recorded by the Uganda Revenue Authority between 1994 and 2010 are graphed in Figure 2.1.[2] Prior to the mid-1990s very little if any fertilizer was marketed to smallholder farmers by the private sector, and even fewer smallholders used any fertilizer. Fertilizer was brought into the country primarily for cash crop production. Large-scale producers of tea and sugar were and continue to be important consumers of fertilizer, importing the product either directly or through tenders. Significant quantities also go to smallholder tobacco producers under a contract farming system. Plantations of oil palm with accompanying outgrower schemes are now adding to this demand from large-scale producers.

Figure 2.1—Total annual fertilizer imports for Uganda, 1994–2010



Source: Uganda Revenue Authority import database.
Note: DAP, diammonium phosphate; mt, metric ton; NPK, nitrogen phosphorus potassium.

While available data do not allow a disaggregation of imports between large-scale users and smallholders, some part of the increase in fertilizer consumption in Uganda since 2000 is likely a result of increasing smallholder uptake of the input. This is primarily a result of the reforms in agricultural markets and parastatal institutions that took place in the 1990s in Uganda. Tukacungurwa (1994), reviewing fertilizer use in Uganda just as these reforms were gaining speed, argued that the noncompetitive, government-managed system of fertilizer importation and distribution in place then restricted access of smallholders to fertilizer and, consequently, virtually no use of fertilizer by smallholders was seen. The study noted that no private traders imported fertilizer for sale to smallholders in 1994. Since then a wholly private-sector-managed fertilizer supply system has been put in place. The government's role is limited to regulation and, to a very limited degree with regard to fertilizer, advisory services. The government has not subsidized fertilizer supply for smallholder farmers since the reforms of the 1990s. Nonetheless,

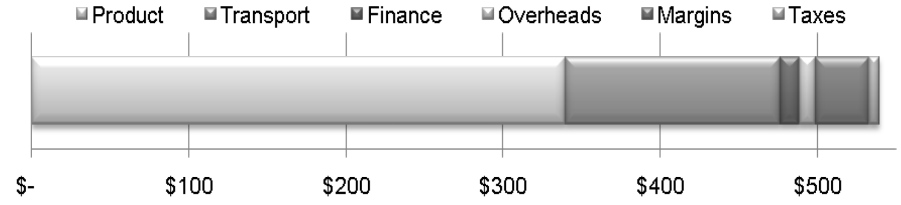
[2] Figure 2.1 shows fertilizer imports on the basis of fertilizer product quantities, not nutrient quantities. Based on the mix of fertilizers reported in the trader survey, the average total N, P_2O_5, and K_2O nutrient content of fertilizers imported to Uganda is about 45 percent. On this basis, imports of nutrients in recent years amount to about 18,000 nutrient tons annually.

maize, coffee, and vegetable farmers, in particular, seem to be increasingly recognizing that profitable use of inorganic fertilizer is possible on these crops, so fertilizer use by smallholders is increasing.

The growth in imports shown in Figure 2.1 is impressive, but the small absolute quantities involved must be recognized. Although the total amount of cultivated land in Kenya is only slightly lower than that in Uganda, in 2010 Kenya imported an estimated 480,000 metric tons (mt) of fertilizer—10 times the amount brought into Uganda (Ariga and Jayne 2011). About 100,000 km^2 of Uganda's total land area of 199,800 km^2 is cultivated (UBOS 2010). The recent annual imports of 40,000 mt of fertilizer per year correspond to fertilizer product application rates on this cultivated land of 4 kg/hectare (ha), or around 1.8 kg/ha of nutrient per year. Average application rates on smallholder fields are significantly lower than this, given the substantial proportion of fertilizer imported by large-scale commercial agricultural producers and the higher rates applied to their fields. The 2005/06 Uganda National Household Survey estimated that only 1 percent of smallholder farmers nationally applied inorganic fertilizer to any of their crops (UBOS 2007). In spite of increasing uptake of the technology over the past 10 years, fertilizer use by smallholders in Uganda remains much more the exception than the rule.

Because fertilizer is an imported commodity from international suppliers coming to a landlocked country 1,000 km from its main port with no fertilizer subsidies in place, global commodity and transport prices are the primary determinants of the price that fertilizer users in Uganda pay for the input. A study in 2006 of fertilizer supply in Uganda estimated the landed cost of fertilizer in Kampala to be US$ 540/mt[3] (Figure 2.2) (Chemonics International and IFDC 2007). Of this price, the free-on-board (FOB) commodity price at the source accounted for 53 percent of the total price in Kampala, while transport from the shipping port to Mombasa, Kenya, and on to Kampala accounted for 25 percent. The margins obtained by the importers and traders accounted for an estimated 5.3 percent of the cost, less than those in other landlocked countries included in the study. At least according to these data, a relatively competitive market situation is in place in Uganda.

Figure 2.2—Components of average price of fertilizer delivered to Kampala, 2006, US$ per metric ton



Source: Chemonics International and IFDC, 2007.

No price series for fertilizer extending over the past 10–15 years could be obtained for this study. Globally, fertilizer prices have been quite volatile over the period 2007–2011, and significantly higher than the 2006 prices shown in Figure 2.2. Table 2.1 compares average international export prices with local Uganda retail prices (average of prices from retailers in several market centers) for the period August 2010 to January 2011. Although the export and local Uganda retail prices are somewhat higher than seen in 2006, the proportion of the Uganda retail price made up by the international export cost is similar to the 53 percent seen in the 2006 study.

[3] All dollar amounts are expressed in U.S. dollars.

Table 2.1—Fertilizer prices, comparison of Uganda retail price to free-on-board price from international suppliers, US$ per metric ton, average August 2010 to January 2011

	Local retail price, US$	Int'l export price, US$	Export price component of local price, %	*Export source*
Urea	709	352	49.6	*Arab Gulf*
Diammonium Phosphate (DAP)	976	546	55.9	*Baltic*
Triple Superphosphate (TSP)	994	449	45.2	*North Africa*

Source: http://www.amitsa.org.

Although the focus of the research from which this paper was developed is on assessing whether taxes or missing public goods and services account for some of the high price of fertilizers in Uganda, it is clear that these elements of the price are relatively small. Uganda is a price taker for fertilizer from international markets, so it can do little about that element of the landed cost of fertilizer in the country. However, there is more scope for action related to transport. Options for government action include improving domestic transport infrastructure to reduce the costs of distribution after the fertilizer comes into the country. It also includes working with the government of Kenya to improve Mombasa port operations, to reduce the cost of transiting the fertilizer across Kenya by road or rail, and to speed up the procedures for moving the fertilizer across the border into Uganda. Smaller gains can be achieved through improving access to finance by importers, reducing the overhead charges that dealers incur, and removing any taxes and fees levied on fertilizer importers and dealers that work against the objectives of improving agricultural productivity and the profitability of farming for Ugandan smallholders. This last point is the focus of the research reported in this paper.

3. SUPPLY: FERTILIZER IMPORTATION AND MARKETING IN UGANDA

In this section, three elements of fertilizer supply in Uganda are considered. The first is the legislation that governs importation and trade of inorganic fertilizers in the country. These laws and regulations justify the regulatory framework that the Ministry of Agriculture, Animal Industry, and Fisheries (MAAIF) has put in place and under which fertilizer importers and traders must operate. The second element is the operations of fertilizer importers. This information is principally derived from a series of qualitative interviews conducted with fertilizer importers and others who oversee or are affected by their operations. The final element of this section is a brief discussion of the general pattern of fertilizer retailers across Uganda. This final subsection is relatively brief because considerably more detail on fertilizer traders is provided in Section 4, which also includes the results of the fertilizer trader survey conducted for this study.

Legislation

Two pairs of laws and regulations have been put in place in Uganda in the past 25 years to regulate the importation, distribution, storage, and marketing of agricultural chemicals, including inorganic fertilizer: a 1989 statute with 1993 regulations to define how the statute is to be implemented in practice, and a 2006 act with draft regulations specifically for fertilizer that in 2011 were still awaiting the assent of the minister of agriculture. Box 3.1 discusses the key characteristics of the operative law and the regulations, in place and proposed, to implement the law with regard to inorganic fertilizer.

Box 3.1—Legislation in Uganda regulating importation, distribution, and marketing of fertilizer

The Agricultural Chemicals (Control) Act, 2006	• By this act, the Control of Agricultural Chemicals Statute, 1989, was repealed. The content of the two laws is similar, however. Much of 2006 act simply reconfirms what was established by the 1989 statute. • Agricultural chemicals are defined to include pesticides, fertilizer, growth regulators, or any other chemical material used for agricultural purposes. The list of chemicals covered by the 1989 statute is somewhat expanded. • Any agricultural chemical manufactured, imported, or sold in Uganda must be registered, packed, and labeled in accordance with the act. ○ Language is clearer than that in the earlier statute on requirement that any dealer in agricultural chemicals must be registered and have his or her business premises registered with the board. • Confirms establishment of an Agricultural Chemical Board to oversee registration of agricultural chemicals, regulate their quality and importation, and manage licensing of agricultural chemical dealers and their premises. ○ Confirms the Agricultural Chemicals Technical Committee to advise the board. ○ Uganda National Bureau of Standards (UNBS) represented only on the Technical Committee. • Establish a cadre of inspectors, analysts, and registrars of agricultural chemicals. ○ Inspectors may enter any place in Uganda in which it is believed that agricultural chemicals are produced, stored, sold, or used; may take samples and require documentation on any chemicals inspected; and are permitted to seize chemicals produced, stored, sold, or used in contravention to the 2006 act or other regulations. ○ UNBS has no role in the registration of agricultural chemicals or dealers, nor are UNBS inspectors involved in inspections to assess the suitability of agricultural chemicals being imported and sold in Uganda or the compliance of traders with the regulations of the statute. • Notes that the minister of agriculture, in consultation with the board, may make regulations specifically prescribing “the types, formulation, quality, registration, storage, and use of fertilizers.” • Act was enacted by Parliament.

Box 3.1—Continued

The Control of Agricultural Chemicals (Registration and Control) Regulations, 1993	• The regulations established by the minister of agriculture under the authority of Section 15 of the 1989 statute to prescribe the procedures under which the 1989 statute will be implemented. These regulations are still in force while new regulations under the 2006 act are being reviewed (see below). • Fertilizer is not singled out as different from other agricultural chemicals in any way. The management of pesticides under these regulations will also apply to fertilizers. • Specifies three registers: Agricultural chemicals o "Fumigators and commercial applicators," including those who manufacture, import, export, store, use, distribute, or otherwise deal in agricultural chemicals o Premises used for manufacture, distribution, formulation, packaging, and storage of agricultural chemicals • Establishes procedures for registration of agricultural chemicals, particularly on the documentation on the product required. o Provisions are made for testing of samples of chemicals submitted for registrations in both laboratory and field. Although not clearly stated, this may be required only at the discretion of the Agricultural Chemicals Board. • Procedures for registration of "fumigators and commercial applicators," including traders selling agricultural chemicals. Applicant must provide evidence that she or he has requisite technical knowledge. o Registration is specific to the chemicals that the individual has demonstrated expertise to manage—not for all agricultural chemicals. o Condition of registration is that the individual shall keep a record of all of the quantities of agricultural chemicals he or she deals with and shall submit annual reports to the registrar. • Procedures for registration of premises. Cannot operate a registered premise unless activities there are immediately supervised by a registered individual. • Importation of fertilizer requires that fertilizer to be imported is registered and that importer also is registered. • Establishes labeling requirements for agricultural chemicals. Specifically states that no agricultural chemical can be sold or used without a label. o However, also states that every distributor of agricultural chemicals should provide a range of package sizes that can be safely and appropriately used by small-scale farmers. • Presents an extensive set of application forms, registration certificates, labels, and register pages to be used for implementing the procedures defined by the regulations. • No reference is made in the regulations to the Uganda National Bureau of Standards and any role that the bureau may play in registration of agricultural chemicals or dealers.

Box 3.1—Continued

The Fertilizer Control Regulations, 2011—draft of May 2011	These draft regulations have been developed to prescribe the specific procedures with regard to fertilizer under which the 2006 act will be implemented. As this document may change before ministerial assent is obtained, only general comments are provided here.
	• These regulations are focused on fertilizer alone. Separate pesticide regulations have been drafted.
	  o In the draft fertilizer regulations reviewed, the separation of fertilizer from pesticides is not done successfully. The draft regulations for pesticides were drawn up prior to the development of the draft fertilizer regulations. Much of the language from the draft pesticides regulations was used here. In consequence, for the most part, the same level of regulation applies to fertilizers as to pesticides.
	• The structure and content of these regulations is quite similar to that of the 1993 regulations, except:
	  o The register of fumigators and commercial applicators is now specified as a register of dealers and manufacturers.
	  o A set of product standards for an extensive set of inorganic fertilizers is included in an attached schedule.
	  o Considerably more detail is provided on ensuring compliance and enforcement of the regulations.
	• Fertilizer import permit is still required following the procedures established in the earlier regulations.
	• Premises used for the sale, storage, packaging, or manufacturing of fertilizers must be registered.
	• Registration of agricultural chemicals apparently no longer applies to high-analysis inorganic fertilizer (total N:P:K > 24 percent).
	  o Foliar, controlled release, low analysis, and biofertilizers still require registration.
	• Uganda National Bureau of Standards is not implicated in these regulations, except to state that standards for fertilizer established by the Uganda National Bureau of Standards Act, among other legislation, will be used to regulate the quality of fertilizer permitted to be imported and sold in Uganda.

Source: Summarized from the legislation by authors.

These laws and regulations establish quite a comprehensive set of rules that govern how agricultural chemicals, including fertilizer, are to be made available to Ugandan farmers. The principal elements of the legislations are that all agricultural chemicals manufactured, imported, or sold in Uganda must be registered, packed, and labeled in accordance with the act. All dealers in agricultural chemicals must be registered and demonstrate a certain level of knowledge concerning the use of the products in which they deal. Finally, all premises used for activities related to agricultural chemicals also must be registered. Importation of agricultural chemicals into Uganda requires an import permit. Such permits will be given only to registered dealers in agricultural chemicals who seek to import registered products. Agricultural inspectors have been put in place to enforce these regulations.

MAAIF is responsible for implementing the regulations with the objective, as stated in the draft 2011 regulations, of controlling fertilizer importation, manufacturing, storage, distribution, trade, and use "to ensure good quality fertilizers for farmers and to protect private sector investment against harmful practices in the market." The principal office responsible for overseeing the implementation of these laws and regulations is the Department of Crop Protection, which lies within the Directorate of Crop Resources of MAAIF. This office manages the registers for agricultural chemicals, dealers and manufacturers, and premises and is responsible for issuing fertilizer import permits. The agricultural inspectors at the principal border posts of the country (inspectors are at 5 of the 28 official border posts in Uganda) and elsewhere in Uganda report to the Commissioner for Crop Protection of MAAIF.

Registration fees are associated with each type of register. Staff members of the Department of Crop Protection stated that the first registration of a fertilizer product costs UShs 500,000 (Ugandan shillings) and is valid for three years.[4] Subsequent renewals cost UShs 250,000 per producer and are valid for two years. Registration as an agrochemical dealer costs UShs 250,000 and is also valid for two years. The registration of agrochemical premises costs UShs 50,000 annually. The department staff members estimated that fee collections from the registration of chemicals, dealers, and premises total UShs 70 million annually, although they were of the opinion that total fees collected would be more than that if the department were provided sufficient resources for enforcement. The registration fees are not kept by the department or by MAAIF but go to the central government resources pool with the Ministry of Finance. Resources for the agrochemical inspections and for enforcement come from the general MAAIF budget allocation from the Ministry of Finance and are felt by the Ministry of Agriculture to be insufficient to conduct systematic inspections and agro-input market surveillance.

In reviewing the legislation with attention to fertilizer, at least three issues of a policy nature arise: distinctions between products within the overall agrochemical category of products; a role for the Uganda National Bureau of Standards (UNBS) on regulating and enforcing agricultural chemical or inorganic fertilizer quality and safety; and finally, costs related to the bureaucratic procedures required for the importation and marketing of inorganic fertilizers that provide only limited public benefits.

First, only in the draft 2011 regulations is any distinction made between pesticides and inorganic fertilizer. The operative law, the 2006 act, treats all agricultural chemicals the same, without distinction as to their relative potential risks for public health and security. Most scientists would agree that the risks to public safety posed by pesticides are significantly greater than those that arise from the use of inorganic fertilizers. High-analysis inorganic fertilizers have been manufactured through industrial production for almost 100 years in factories that require significant investment and high levels of output to be economically viable. Total global production of fertilizers in 2010 was estimated at around 210 million metric tons (mt) of nutrients (N, P_2O_5, K_2O) (Heffer and Prud'homme 2011). As standard commodities that are traded globally, the properties of high-analysis fertilizers are well known, as are the risks associated with their use.

The situation with pesticides is quite different. A broad range of pesticides is offered on the Uganda market. As poisons that work through killing plant, animal, and microbial pests, pesticides are clearly associated with public-health concerns. It is in the public interest to have appropriately trained people dealing in pesticides and advising on their use. Likewise, the safety and efficacy of the broad range of pesticides available should be assessed. The regulation of agricultural chemicals in place in Uganda does provide a necessary barrier to the market for pesticides and other agricultural chemicals that, without controls, may result in harm through improper use or through the offer for sale in Uganda of dangerous chemical formulations.

But such close controls are not necessary on the importation and use of the standard high-analysis inorganic fertilizer used in Uganda—urea, calcium ammonium nitrate (CAN), diammonium phosphate (DAP), triple superphosphate (TSP), 17:17:17; and 25:5:5+5S. First, these fertilizers are standard global commodities that have been safely used by millions of farmers for many decades, and their nutrient quality and content can be expected to lie within a relatively narrow band. The regulations now in place requiring registration of individual high-analysis fertilizer products from all international suppliers, and the import permits required to then bring in the products, limit access to the Ugandan market by international suppliers. This in turn results in limits on supply to smallholder farmers and effectively raises the price that they must pay for inorganic fertilizer. As such, separate laws and regulations are needed in Uganda for pesticides and any new and unknown agricultural chemicals (including new inorganic fertilizers) on the one hand, and for the common high-analysis inorganic fertilizers on the other.

Second, the laws and regulations give only a very small role for UNBS, the statutory agency responsible for enforcing standards in Uganda for public health and safety and for guarding against trade in dangerous, counterfeit, and substandard products. While convincing arguments can be made that

[4] At the time of the study in late 2010 and early 2011, UShs 2,250 = US$1.00.

experts in agriculture should be involved in the assessment and regulatory control of pesticides, new and nonstandardized fertilizers, and other agrochemicals, this is not the case for standardized agricultural inputs with low risk to human health and security, such as the high-analysis fertilizers commonly used in Uganda. UNBS inspectors and laboratory analysts can be expected to be able to readily assess the quality of these fertilizers. Placing the quality assurance of high-analysis fertilizers within the responsibility of UNBS, rather than MAAIF, would permit a much broader set of distribution and marketing channels to be used for the sale of fertilizer. However, a key complementary action to such a change in the regulatory framework would be to significantly increase the information made available to consumers on the proper use of fertilizer. In sum, MAAIF should retain a regulatory role on the importation, sale, and use of agricultural chemicals where there is need for specialized knowledge in ensuring public safety. However, where no such need exists, as for standard, high-analysis inorganic fertilizers, this role should devolve to the statutory agency concerned with enforcing product standards, the UNBS.

Finally, while import permits are provided by MAAIF to the importer at no direct cost, considerable indirect costs are associated with following the regulations for the importation of fertilizer. The importer must be registered as a fertilizer dealer. Registration requires documented training on the use of agricultural chemicals—for fertilizers as well as other chemical products, followed by application for registration and payment of annual license fees. The importer also must be assured that the fertilizers that he or she will be importing are registered for use in Uganda. Finally, the import permit can be obtained only at MAAIF headquarters in Entebbe, necessitating travel to apply for and then again to collect the permit. All of these procedures impose costs in time and money for the fertilizer importer—costs that he or she will need to recover in the sales price of the fertilizer. The price will need to be sufficient to cover the cost of the fertilizer plus all costs related to importing the product, including these regulatory costs. The benefits in terms of public health and safety from imposing these sorts of regulatory costs on the importation and sale of a standardized global product like high-analysis inorganic fertilizers are quite small. Strong consideration should be paid to streamlining this process, if not doing away with it altogether, so that farmers derive the benefit of lower prices—benefits that likely exceed the value of any benefits from close regulation of fertilizer importation and marketing in Uganda.

In summary, Uganda has a well-developed system of control on the importation, marketing, and use of inorganic fertilizers—although the regulations are certainly better developed in their design than in implementation due to resource constraints. However, particularly with regard to high-analysis fertilizers that are standardized global commodities, the regulatory system as designed is excessive—both in terms of the direct and indirect costs associated with following the regulations and in terms of the benefits for public health, safety, and welfare for which the regulations have been put in place. A major reason that the costs associated with following the regulations significantly exceed the public benefits obtained is that the regulatory system treats fertilizer similar to other agricultural chemicals, including pesticides, which clearly do require such a level of oversight. Policy reform is needed to reduce the regulatory burden faced by importers and dealers of fertilizer in Uganda.

Operations of Fertilizer Importers

Regular assessments of the principal importers of fertilizer in Uganda that have been conducted over the past 20 years demonstrate how this sector of the fertilizer supply chain has evolved. Importers generally also serve as the main fertilizer wholesalers in Uganda, while often having a retail side to their business as well.

Tukacungurwa (1994) lists the principal importers of the early 1990s when about 5,000 to 6,000 mt were imported annually. Commercial agricultural producers—Uganda Tea Growers Corporation, British-American Tobacco, Kakira Sugar, Toro Mityana Tea Company, Sugar Corporation of Uganda, and others—accounted for at least 60 percent of all imports. The other importers were mainly the Ministry of Agriculture, responsible for distributing donor grants of fertilizer and for various agricultural development projects. No private commercial importers were involved at the time. Stocks were obtained from the international market delivered through the port of Mombasa, Kenya.

By the early 2000s, amounts imported approached 20,000 mt annually, and a concentrated set of private-sector importers started operating, most based in Kampala, with a handful also in Mbale in eastern Uganda (IFDC, SG 2000, and IDEA. 2003). While the commercial agricultural producers still dominated the list of fertilizer importers in 2002, Balton (U) Ltd., a commercial agro-input supplier, was the largest importer of fertilizer, bringing in more than a quarter of all supplies. Several smaller importers were also in business, so that the commercial importers accounted for two-thirds of all imports (Omamo 2003). Notably, government and projects no longer featured in the list of importers. However, most commercial importers operated as brokers, responding to requests for tenders by large fertilizer users such as commercial agricultural producers. The stocks of fertilizer for resale that commercial importers maintained were quite small.

Many of the importers in 2002 were found to be acquiring their stocks from Kenya, rather than on the international market. Changes in Kenya's fertilizer market in the preceding years had allowed for increased competition and economies of scale there, leading to greater stocks available in Kenya at attractive prices for Ugandan importers. Importers were also found to be combining crop exports with fertilizer imports—delivering maize and beans to the Kenya market and returning with fertilizer as a back load on their truck.

By 2004, 11 firms imported more than 1,000 mt annually (Omiat and Diiro 2005). Of these, 6 were private agro-input firms, the others being large-scale producers. The largest importer was Uchumi, a general agro-input importer. Procurement from Kenya increased in significance, in part reflecting the financial constraints faced by smaller importers in acquiring the large quantities of fertilizer needed to make direct importation from overseas suppliers a profitable business proposition.

In late 2010, at the start of the research for this paper, the amounts of fertilizer imported into Uganda had increased to about 40,000 mt annually. The number of importers responsible for bringing this fertilizer into the country also had increased to 10–15 firms, with more of them now serving a cash-and-carry market of both small and large farmers rather than deriving most of their business from responding to requests for tenders from large-scale agricultural producers. Several of the importers are Kenyan firms that have now opened up offices in Uganda. However, smaller-scale indigenous Ugandan fertilizer importers are also now operating. Kampala remains the main base for the headquarters offices of fertilizer importers, with some still located in Mbale and two or three importers now based in Masaka, west of Kampala. Longer-term observers of fertilizer importers in Uganda noted, however, that some of the stronger importers in the past are no longer so prominent. Their interpretation of these changes is that margins for Uganda's fertilizer importers are quite tight and the volatility of global fertilizer prices in recent years has made importing fertilizer a relatively risky business.

Kenya is now the principal source of supplies of fertilizer for importers that serve smallholder farmers in Uganda. Such importers are able to purchase fertilizer stocks in Nairobi from the depots of large suppliers there by the 28-ton truck load. Purchasing fertilizer in these smaller lots keeps their financing requirements manageable and reduces their exposure to risk of unsold inventory constraining cash flow in their business. Mea Ltd., a Kenyan firm with a blending plant in Nakuru and depots in Nairobi, Nakuru, and Eldoret; SKL (Shah Kanji Lalji and Sons, (Kenya) Ltd.), another Kenyan firm; and Yara, an international firm with depots in both Mombasa and Nairobi, were the Kenyan suppliers most frequently mentioned by importers in Kampala.[5]

Quite a range of fertilizer is imported to provide retailers with fertilizers to sell to smaller farmers —likely a wider range than is actually justified from an agronomic standpoint. The explanation given for this was that each crop is associated with a particular basal and top-dressing fertilizer. Also, some regions have their own particular fertilizer-type preferences for a crop that differ from those used on the same crop in other farming areas of Uganda. So, while urea and CAN may be quite similar as relatively high

[5] About four years ago, Yara explored setting up a depot in Kampala but apparently felt the market was too small to justify doing so. Reflecting on the option of having a large wholesale depot for fertilizer in Kampala, several importers interviewed expressed satisfaction that Yara stayed out of direct participation in the local Ugandan market, as this would have sharply curtailed their own scope of operation.

analysis N-fertilizers, urea is known as a maize top-dressing fertilizer, while CAN is known as the fertilizer for coffee in some areas (not all), so the dealer will need to stock both. This practice of keeping a quite extensive stock of different fertilizers for specific crops increases business risk, particularly for the smaller importers. As their capital is locked up in their stock, after they have made their purchases of fertilizer, they lose flexibility. If output prices for a particular crop during the previous season were such that farmers switch out of the crop for the coming season, an importer who is not aware of this change in farmer crop preference may end up at the end of the selling season with significant stocks of unsold fertilizer of the types that are mainly used on the crops now out of favor with farmers.

Virtually all of the fertilizer brought into Uganda is bagged in 50-kilogram (kg) bags. One interview mentioned a large-scale agricultural producer bringing in bulk fertilizer in shipping containers in 2010, but this method of importation is not common. No importers who serve small-scale farmers bag their product in Uganda. As such, all fertilizer that is found on the market is in 50-kg bags. Smaller quantities of fertilizer are sold to individual customers, but these are generally packaged at the point of sale in poorly labeled plastic bags—illegally so, contravening the regulations on the manner in which agricultural chemicals can be sold, as was described above.

Transport of Fertilizer Import Shipments

Transport costs for fertilizer from Kenya are no different from that of any general cargo. The transport costs for a 28-ton truck load of fertilizer is $2,000–$2,200 from Nairobi to Kampala and $3,000–$3,300 from Mombasa to Kampala. Fees to be paid at roadblocks are included in these fees, but the transporters with whom we spoke did not feel that these added significantly to costs.6 Transporters, if operating vehicles not registered in Uganda, also factor the Ugandan road tax into their transport fee. However, the importer is responsible for costs of loading and unloading the vehicles and insuring the shipment while it is in transit.

Most importers and transporters contacted for this study are unwilling to ship fertilizer using the rail system connecting Kampala to Mombasa that is now run by the Rift Valley Railways consortium. Wagons capable of handling 23 mt of fertilizer are allocated to shippers in blocks of 18 to 23 wagons, requiring considerable quantities of cargo for cost-effective use. There is a general shortage of wagons due to inefficient rail-side discharge and loading operations. Moreover, Ugandan shippers claim that they are allocated wagons only that are surplus to the immediate requirements of Kenyan transporters. The transport costs for a 23-ton load of fertilizer by rail from Mombasa to Kampala is $2,200, so somewhat cheaper than by road. However, one transporter in Kampala was of the opinion that the costs that build as an importer faces the delays commonly experienced when using rail transport—for storage, financing, and the like—would generally equal or exceed any transport cost savings obtained from using rail over shipping by road. The only shipments of fertilizer that were reported to come into Uganda by rail in 2010 were bulk orders for commercial agriculture firms, notably sugar and tobacco.

Border Processing of Fertilizer Import Shipments

Importers of fertilizer require a clearing agent to process the shipment from Kenya into Uganda. The clearing agent will ensure that all documents concerning the fertilizer shipment are in order and presented to the proper authorities. Clearing agents will charge between $100 and $150 to clear a 28-ton truck trailer load of fertilizer.

[6] Between Mombasa and Busia are about 20 fixed roadblocks, plus 5 or more mobile roadblocks. There are 10 to 12 fixed roadblocks between Nairobi and Busia. Each will require KShs 100 to 200 (Kenyan shillings) to pass through. In total, roadblock fees will cost about KShs 5,000 ($60) in going from Mombasa to Busia. Roadblocks are fewer in Uganda, and transporters said that often one's way can be talked through without payment. They estimated charges of at most UShs 20,000 (less than $10) in going from Busia to Kampala.

A clearing agent brings expertise to a situation where the importer may not be well informed on the rules on bringing into Uganda a bulk shipment of goods. The agricultural inspectors and the Uganda Revenue Authority (URA) agents at the border made it clear in our discussions with them that they do not want to deal with the actual importers but only with the more knowledgeable clearing agent as a representative of the importers. However, both the inspectors and the URA agents noted that some clearing agents did not have quite as much expertise as they should have to be effective representatives for their clients. The border crossings between Kenya and Uganda seem rife with misinformation. Indeed the clearing agents seem to have incentives for ensuring a low level of knowledge of most merchants on the procedures for passing goods through the border.

The clearing agents provide documentation services to the importers. On the Kenyan side of the border, authorities require a standard form of the East African Community (EAC) on the contents of the shipment being exported. For fertilizer, this form is used principally for statistical purposes, since fertilizer exports do not attract any fees; however, clearing agents interviewed stated that an importer bringing in fertilizer will have difficulty clearing the Kenyan side of the border without this form being submitted. Moreover, this form is also presented to the Ugandan revenue authorities.

On the Ugandan side of the border, all imports of agricultural inputs must be examined by agricultural inspectors before the customs agents of the URA will process the shipment in any way. The agricultural inspectors, employees of the Ministry of Agriculture, Animal Industry, and Fisheries (MAAIF), require that all shipments leaving Kenya are accompanied by three documents, which the clearing agent presents:

- An import permit from MAAIF Commissioner of Crop Protection in Entebbe that states the type(s) and quantity of fertilizer to be imported and from what source it was obtained. The issuance of a permit requires that the product being imported is registered with MAAIF for use in Uganda.
- A commercial invoice on the shipment from the supplier.
- A certificate of chemical analysis on the product, provided by the fertilizer supplier. However, although rarely done, the inspectors reserve the right to take samples of fertilizer for verification at laboratories at Makerere University, the UNBS, or the National Agricultural Research Organization. The shipment is held at the border until verification is obtained.

If all documentation is in order, the agricultural inspection process is generally done efficiently. Only if documents are not in order will the shipment be held at the border until the importer obtains the proper documentation either from the supplier (via invoice or certificate of analysis) or from MAAIF (via import permit). On occasion, if the products being imported are suspect, the inspectors will seize them; but the inspectors noted that this was rarely done with fertilizers but more common with pesticides. The agricultural inspectors provide no fee-based services. They neither invoice anyone nor accept payment from anyone.

Having completed the inspection of the shipment of fertilizer, the clearing agent will then present the EAC shipment documentation form to the URA agents for clearance. The clearing agent will be responsible for providing URA with some indication of how the URA should treat the shipment in terms of tariffs, value-added tax (VAT), and withholding tax, based on the clearing agent's knowledge of the import and export regulations. Fertilizer is "zero-rated" in the East African Customs Management Act, Fifth Schedule, Part B-11. Therefore, no duty, VAT, or withholding tax should be levied on fertilizer shipments. Fertilizer has been zero-rated in the EAC since at least early 2005 and in Uganda since 2002 through legislation in the Finance (no. 2) Act, 2002. As such, the information provided URA by the clearing agent on the shipment is used primarily for statistical purposes.

Withholding tax has been a recurrent issue in studies over the past 10 years on where efficiencies can be gained in fertilizer supply for Uganda. Early studies stated consistently that withholding tax was charged on fertilizer shipments. However, all of our repeated inquiries with URA officials received the clear response that no withholding tax is or should be charged on fertilizer. Withholding tax is a

mechanism for tax compliance, particularly on income tax. Where no tax is owed, such as on a zero-rated good like inorganic fertilizer, no compliance is required.

However, in the course of our study it became clear that coding errors on the part of the clearing agent may result in withholding tax being charged on a fertilizer shipment. Regarding processing such shipments, one clearing agent noted having considered only whether the fertilizer importer was exempt from withholding tax due to good tax compliance in the past and had in possession a withholding tax exemption certificate from the URA. For such clients, a Customs Procedure Code (CPC) of 405 is used. Those who did not qualify for the 405 code would be charged withholding tax on their fertilizer imports. However, upon further discussion in the course of our interview, the clearing agent realized that all importers of fertilizer, whether or not they qualify as exempt from withholding tax, should receive a CPC code of 472, which indicates that the product being imported is zero-rated, and withholding tax, VAT, and duty are not required.

If withholding tax is charged on a shipment of fertilizer, the URA will accept payment of this tax and apply it to the account of the taxpayer. The URA does not have in place a system to reject withholding tax payments made for zero-rated goods. Any withholding tax thus obtained will be credited to the taxpayer's income tax obligation, and the taxpayer will have to pay only any balance owed. In the event that the taxpayer's credit is more than his or her tax liability, this amount can be claimed or carried forward to subsequent tax years.

This discussion indicates the general level of misinformation on how fertilizer should be taxed at importation. Although the information constraints identified with regard to fertilizer typically have to do with enabling farmers to make efficient use of the input, another important information constraint is ensuring that those involved in processing shipments of fertilizer into Uganda know exactly how it should be treated. Efforts are needed to ensure that customs clearing agents have the correct information on how to handle fertilizer and that they use this knowledge correctly.

Finally, with regard to processing a fertilizer shipment at the border post, if the shipment is brought into Uganda on a foreign-registered truck, a road tax must be paid to URA upon importation, depending on the destination and truck size. A 28-ton semitrailer truck would pay $10 per 100 km (UShs 102,000 from Malaba to Kampala in November 2010). Smaller trucks pay $6 per 100 km. For Uganda destinations, the round-trip distance to the destination and back to the border is charged. For transit vehicles (going to Rwanda, Democratic Republic of the Congo, or Sudan), only the one-way distance is charged. We were informed that the transporter pays this road fee, not the importer. After any required road tax is paid, the fertilizer shipment can clear the border.[7]

Incentives for Smuggling Fertilizer into Uganda

In the course of our interviews, we asked respondents to consider possible incentives for smuggling fertilizer into Uganda, as smuggling does go on. Most felt that people chose to smuggle fertilizer primarily because either they simply do not know what they need to do to legally import fertilizer or the documentation for their fertilizer is not in order. Three documents are required at the border—a fertilizer import permit, a chemical analysis certificate, and an invoice. An importer who obtained fertilizer in a manner that was not fully legal may not have the chemical analysis certificate or an acceptable invoice to present to the agricultural inspectors. A new fertilizer supplier in Kenya or elsewhere may not have registered their products for sale in Uganda, even if supplying standard industrial fertilizers, so these products would not be permitted for import into Uganda. A first-time importer may not be aware of the need to have an import license, so even with the proper documentation on the purchase and quality of the fertilizer, the shipment would be held at the border until an import license was obtained.

[7] Ugandan registered trucks going to Mombasa or Nairobi to collect a shipment of fertilizer to bring to Uganda must either purchase an annual transit license costing approximately $500 per truck per year or pay a per-trip road fee. This is similar in form and cost to that faced by non-Ugandan trucks operating in or through Uganda.

Although no direct out-of-pocket expenses are associated with the immediate paperwork needed for fertilizer importation, as discussed earlier, time and transaction costs are associated with obtaining the proper documentation to import fertilizer into Uganda. The costs in time to acquire the information on how to import fertilizer and then act on that information are quite large. This is particularly true if one is engaged primarily in import–export trade and sees a business opportunity in the importation of fertilizer into Uganda, but is not interested in pursuing a career as an agricultural input dealer. Consequently, if a business opportunity related to importing fertilizer into Uganda presents itself, such individuals may well seek to smuggle the fertilizer into the country using poorly monitored border crossings or under-the-table subversion of the regulations in place on fertilizer importation, thereby avoiding the costs associated with following the regulations.

Nonetheless, most of those interviewed who were asked about fertilizer smuggling, including both importers and officials at the revenue authority, felt that smuggled fertilizer constituted a small amount of the fertilizer brought into Uganda. Fertilizer is a bulky, relatively low value-to-weight product, and so is not a first choice for smugglers. The procedures for legally importing fertilizer, even if perhaps more complex than needed, are relatively easy to understand. As such, most observers estimated that more than 90 percent of the fertilizer in Uganda was imported legally.[8] Official statistics based on reports of agricultural inspectors should be relatively accurate as to the total amount of fertilizer brought into Uganda.

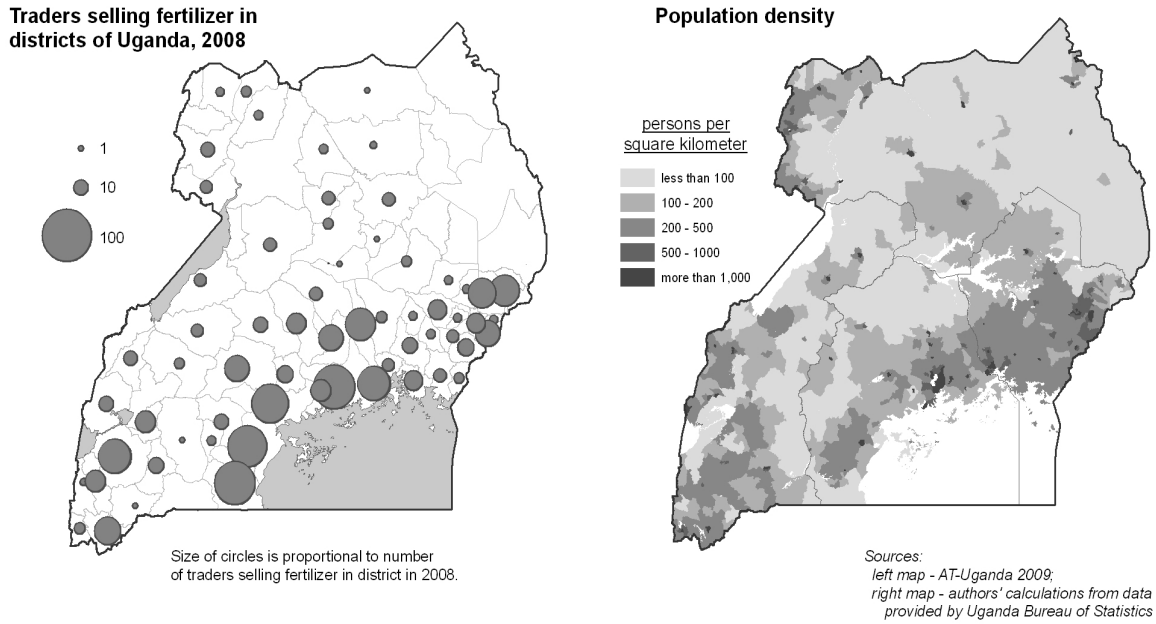
Fertilizer Retailers

In 2008, AT-Uganda coordinated a census of agro-input dealers (AT-Uganda 2009) that enumerated 1,992 agro-input dealers across Uganda. Of these, 966 reported that they sold fertilizer. The left map in Figure 3.1 uses graduated circles to represent the number of fertilizer dealers reported in each district in the agro-input dealer census.[9] Kampala district, with 74 dealers enumerated, has the largest concentration of fertilizer dealers. Seventeen of the 80 districts in Uganda at the time of the agrodealer census had no fertilizer dealers. The right map in Figure 3.1 shows the estimated population density at the subcounty level for Uganda in 2008. A comparison of the two maps shows the relatively close association between the number of fertilizer dealers in an area and the population density of that area. With fertilizer being an agricultural technology that increases the crop productivity per unit of land, the fact that one finds greater access to fertilizer in more densely populated areas of Uganda is not surprising.

[8] Nonetheless, several respondents mentioned smuggled fertilizer being supplied to Ugandan agrodealers by the "Mbale boys." This group of smugglers obtains fertilizer in Kenya that apparently has been diverted from large orders of fertilizer made by western Kenya sugar plantations, brings it into Uganda through minor border crossings, and sells it to dealers at a substantial discount from open-market costs. However, with only anecdotal information on their operations, the amount supplied by this group is not known.

[9] This map is based on the count of fertilizer dealers in each district, regardless of the quantity of fertilizer each dealer sold annually. A map based on quantity of fertilizer sold would be dominated by the map symbols for Kampala and, to a lesser extent, Mbale.

Figure 3.1—Distribution of fertilizer dealers in Uganda by district, and population density of Uganda by subcounty



Source: Left map: AT-Uganda 2009; right map – authors' calculations from data provided by Uganda Bureau of Statistics.

Specialized fertilizer dealers are quite rare. As shown in Table 3.2, most of the fertilizer dealers enumerated in the 2008 agro-input dealer census also sell pesticides, seeds and other planting materials, and agricultural tools. Although agro-input dealers are more likely to sell pesticides, seeds, and tools than fertilizer, more than half of those that sell these other products also sell fertilizer. However, livestock supplies—veterinary drugs and other products and feeds for livestock and poultry—tend to be sold by rather specialized dealers, as separate regulations govern the sale of veterinary drugs, in particular. Most dealers in livestock supplies, while they are likely to sell agricultural tools, do not sell fertilizer, pesticides or seed.

Table 3.2—Cross-tabulation of products sold by agro-input dealers, in percent, 2008

	Fertilizer	Pesticides	Seed	Tools	Veterinary	Feed
Fertilizer	100.0	65.5	65.9	56.7	29.3	30.0
Pesticides	90.2	100.0	86.3	73.4	38.8	41.3
Seed and planting materials	92.5	88.0	100.0	77.4	39.1	43.7
Agricultural tools	75.6	71.1	73.5	100.0	54.5	54.5
Veterinary supplies	22.4	21.5	21.2	31.2	100.0	62.9
Livestock feeds	6.6	6.6	6.9	9.0	18.2	100.0
n	*966*	*1,329*	*1,356*	*1,287*	*737*	*213*
Enumerated agrodealers who sell input, %	48.5	66.7	68.1	64.6	37.0	10.7

Source: AT-Uganda 2009.

One of the more significant developments in private-sector fertilizer supply in Uganda in the past 10 years has been the formation of the Uganda National Agro-input Dealers Association (UNADA). Founded in 2003 with the technical assistance of the agricultural development nongovernmental organization AT-Uganda, the association brings together agro-input dealers—retailers, wholesalers, and importers—for policy advocacy, market development, training, and networking purposes. The UNADA leadership serves as a representative of the agro-input dealers in Uganda at national policy discussions and seeks to advance dealers' interests. Among the policy issues of concern to UNADA are enforcement of agro-input quality standards, access to inventory financing and credit guarantees, and the regulation of the industry. UNADA also has been a partner in implementing several donor-supported efforts to strengthen and extend the agro-input dealer network in Uganda, as well as to improve access to credit by fertilizer importers.

A major element of the work of UNADA is in the training of agrodealers. Training is offered on business management, product knowledge, safe pesticide use, output marketing, and corporate governance. In recent years, the Crop Protection Department of the Ministry of Agriculture has approved a five-day UNADA training course on agricultural chemical marketing and use, including for fertilizer, as adequate training for certification as a registered dealer in agricultural chemicals. The ministry accepts a course-completion certificate from UNADA as sufficient documentation for issuing a license.

4. SURVEY OF TRADERS THAT SUPPLY FERTILIZERS

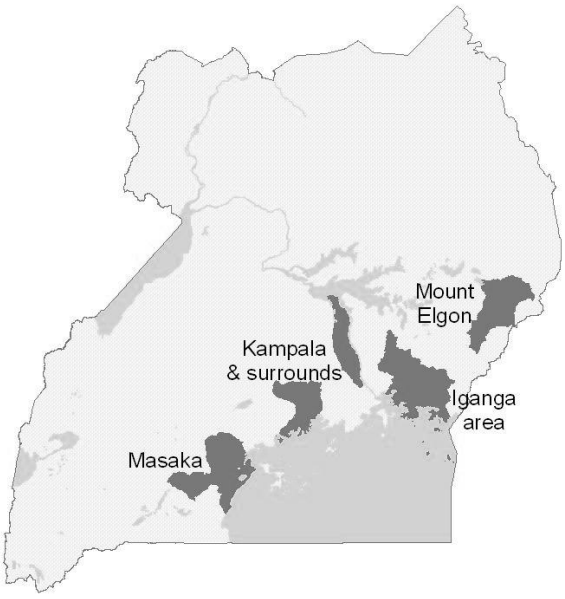
One of the principal ways in which this study obtained information on fertilizer importation and marketing in Uganda is through semistructured interviews with key individuals involved in fertilizer trade, in both the private and public sectors. However, a more formal survey of fertilizer traders, both large and small scale, was also undertaken to obtain a broader and more generalized understanding of their operations. In this section of the paper, we provide some findings from this survey.

Survey Design

A total of 70 traders in fertilizer were interviewed for this study. Through analysis of the agricultural module of the 2005/06 Uganda National Household Survey implemented by the Uganda Bureau of Statistics, four areas of the country with greater prevalence of fertilizer use by farmers on their crop plots were identified[10]:

1. Areas around Masaka in south central Uganda, where fertilizer is used by some farmers on Robusta coffee and maize
2. Districts in the peri-urban area around Kampala—Kampala, Wakiso, and Kayunga—where fertilizer is used on vegetables
3. Iganga area in southeastern Uganda, where fertilized maize is grown
4. Districts on the western slopes of Mount Elgon—Mbale, Sironko, and Kapchorwa—where some maize and Arabica coffee plots receive fertilizer

Figure 4.1—Study areas for both trader and farmer surveys in Uganda



Source: Authors' surveys.

[10] The report on the agricultural module from the 2005/06 Uganda National Household Survey (UNHS) (UBOS 2007) reports that just under 1 percent of crop plots nationally received fertilizer in the first season of 2005. The study areas for both surveys for this study were selected based on somewhat higher levels of fertilizer use reported at district level in the 2005/06 UNHS. Nonetheless, even in these study areas, fertilizer is used on less than 10 percent of crop plots. Further analysis of the UNHS data was done for these study areas to identify the fertilized crops of interest for the study.

These four study areas were used as the strata for both the trader and the farmer surveys for this study. The survey protocol was for 15 to 20 traders to be randomly selected in each of the study areas from a listing of agrodealers who market fertilizer, which was extracted from the database of a national census of agrodealers that was completed in 2008 (AT-Uganda 2009).[11] A standardized questionnaire, which had been pretested with dealers in the Kampala area, was used to interview the selected traders in each study area. This questionnaire was organized in modules on the personal characteristics of the trader, business characteristics, fertilizer inventory, fertilizer supply and supply costs, fertilizer sales, and fertilizer business issues. The trader survey was conducted between late November 2010 and early January 2011.

In the results presented in the tables below, the sample is disaggregated by scale of operation based on the size of the largest order of fertilizer that the trader reported obtaining from a supplier in 2010. Considerable variability was observed in the scale of operations of the fertilizer traders in the study sample. As shown in Table 4.1, traders who reported that their largest order was less than 200 50-kg bags were classified as small scale. Although some traders sold only a handful of bags in 2001, several of the traders in the Kampala area subsample were large importers and wholesalers operating out of the Container Village agro-input market area in Kampala, selling lots of bags, often up to several hundred bags at a time.

Table 4.1—Fertilizer trader scale of operations—size of largest order from supplier in 2010

	Size of largest order in 2010, 50-kg bags of fertilizer				Small-scale traders, (largest order < 200 bags), %	*n*
Study area	Mean	Median	Min	Max		
Masaka	78.7	23	2	500	77.8	*18*
Kampala	351.3	50	3	4,000	73.9	*23*
Iganga	258.1	40	1	2,500	83.3	*12*
Mount Elgon	144.7	60	10	700	64.7	*17*
ALL	213.1	50	1	4,000	74.3	*70*

Source: Uganda fertilizer trader survey.

Fertilizer Trader Characteristics

Table 4.2 provides descriptive statistics on the fertilizer traders in the sample for the survey, disaggregated by scale of operation. No strong differences are observed in the characteristics of the traders by scale. At 28.6 percent, women account for more of the fertilizer traders than might be expected. The engagement of women in the trade varies by area—in the Masaka study area, 39 percent of the subsample were women, while only 17.6 percent of traders in the Mount Elgon area were women. The level of education attained by the traders is relatively good, with the majority having completed secondary school. Some of the large-scale traders have longer experience in the fertilizer trade, skewing the mean upward. However, at the median, there is little difference in experience between large- and small-scale traders.

[11] The results from the trader survey should not be treated as nationally representative, as the strata from which fertilizer traders were selected for the survey were purposively selected based on higher prevalence of fertilizer use in the area. However, the subsample for each study area can be viewed as relatively representative of traders in that area. Nonetheless, we report only unweighted survey results here.

Table 4.2—Fertilizer trader characteristics

	Small-scale	Large-scale	All
Age, mean, yrs	35.8	35.8	35.8
Female, %	28.8	27.8	28.6
Completed primary school, %	96.2	100.0	97.1
Completed secondary, %	50.0	77.8	57.1
Fertilizer trading experience, mean, yrs	8.8	10.4	9.2
median, yrs	8	7	8
n	*52*	*18*	*70*

Source: Uganda fertilizer trader survey.

Table 4.3 provides descriptive statistics on the characteristics of the fertilizer businesses of the traders in the sample for the survey, disaggregated by scale of operation. The median annual sale of fertilizer is 200 bags or 10 mt of fertilizer. Most of the small-scale traders are the sole owners of their business and operate only from a single trading premise. Large-scale traders are more likely than small-scale traders to have partners in the ownership of their business and to have more premises from which they trade. However, most operate from only a single premise. The start-up capital for most traders came from their own personal savings. Only two traders in the sample reported using a commercial loan to finance the start-up of their business.

Table 4.3—Fertilizer trader business characteristics

	Small-scale	Large-scale	All
Annual quantity of fertilizer sold, mean, 50-kg bags	225	5,516	1,585
median, 50-kg bags	150	1,550	200
Sole owner, %	88.5	50.0	78.6
Personal savings as principal source of start-up capital, %	74.5	88.9	78.3
Assets			
More than one trading premise,%	21.6	38.9	26.1
Owns computer, %	15.4	27.8	18.6
Owns pickup truck, %	19.2	27.8	21.4
Owns truck of > 3 mt capacity, %	9.6	11.1	10.0
Has warehouse or other specialized storage space, %	63.5	77.8	67.1
Capacity of storage space for those with storage, mean, 50-kg bags	362	1,110	612
median, 50-kg bags	200	1,000	300
Composition of value of annual sales			
Fertilizer, % of total annual sales	35.6	39.2	36.5
Seeds or other planting materials	22.5	23.8	22.8
Pesticides or other agrochemicals	32.6	29.1	31.7
Farming implements	6.4	6.6	6.5
Veterinary supplies	1.4	0.9	1.3
Agricultural services (not goods)	0.3	1.7	0.6
Nonagricultural items or services	1.8	0.0	1.3

Source: Uganda fertilizer trader survey.

Both small- and large-scale businesses trading in fertilizer have relatively few assets beyond their business premises and storage. Fewer than one-third have any vehicles for transport of goods. The composition of their business sales is specialized in agriculture—few of those in the sample sold any nonagricultural items. However, most fertilizer traders are not specialized in trading in fertilizer alone. Although the largest component of their sales on average comes from fertilizer—as should be expected given that the sample was chosen based on fertilizer trade—both pesticides and seeds are important elements of their business. However, only 4 of the 70 fertilizer traders in the sample reported obtaining 70 percent or more of their total sales from fertilizer alone.

Types and Sources of Fertilizer Sold

Information on the various types of fertilizer and the quantities of those fertilizers that dealers sell is provided in Table 4.4. Urea and diammonium phosphate (DAP) are the most commonly sold fertilizers in Uganda, followed by the NPK blend 17:17:17. Urea and DAP are used principally on maize—DAP as a basal dressing applied shortly after crop emergence and urea as a top dressing applied three to six weeks later when the maize plants are about knee height before the maize flowers. The other nitrogen fertilizer, calcium ammonium nitrate (CAN), is used on coffee and vegetables more than on maize. Its use is regionally specific—none of the traders in the maize growing study area of Iganga reported selling CAN, but it is sold in the coffee and maize areas of Masaka and Mount Elgon. Similarly, 25:5:5+5S is only commonly stocked by traders in the coffee areas. Potassium (potash) fertilizers are not commonly sold in Uganda.

Table 4.4—Fertilizer sales, by type

	Urea (46:0:0)			Calcium Ammonium Nitrate (CAN—26:0:0)		
	Small Scale	Large Scale	All	Small Scale	Large Scale	All
Percentage that sell	96.2	94.4	95.7	46.2	83.3	55.7
Annual sales of those who sold, mean, 50-kg bags	486.9	645.3	527.1	95.6	558.9	273.8
median, 50-kg bags	48	600	80	50	300	80
Price, UShs per 50-kg bag, median	65,000	60,000	65,000	64,550	67,000	65,500
Used principally on:	Maize, vegetables			Coffee, vegetables, maize		
	Diammonium Phosphate (DAP—18:46:0)			**Triple Superphosphate (TSP—0:45:0)**		
Percentage that sell	94.2	100.0	95.7	13.5	27.8	17.1
Annual sales of those who sold, mean, 50-kg bags	461.4	762.8	542.4	18.4	183.2	87.1
median, 50-kg bags	35	500	60	10	50	25
Price, UShs per 50-kg bag, median	90,000	90,000	90,000	80,000	90,000	85,000
Used principally on:	Maize			Maize, coffee, vegetables		
	17:17:17			**25:5:5+5S**		
Percentage that sell	73.1	83.3	75.7	46.2	50.0	47.1
Annual sales of those who sold, mean, 50-kg bags	69.5	2,190.3	669.7	87.1	711.1	257.3
median, 50-kg bags	22.5	500	50	35	200	50
Price, UShs per 50-kg bag, median	85,000	85,000	85,000	80,000	80,000	80,000
Used principally on:	Vegetables; coffee			Coffee; vegetables		

Source: Uganda fertilizer trader survey.

Notes: US$1 = UShs 2,200 at time of survey. Nutrient analysis of fertilizer is in terms of percentage $N:P_2O_5:K_2O$ by weight.

Other types of fertilizer are sold in more limited quantities, and only half of the traders in the sample reported selling any other fertilizer than the six listed in Table 4.4. Of these, most sold various types of foliar fertilizers. Two or three traders reported stocking muriate of potash (MOP) or single superphosphate (SSP). No traders, however, reported stocking any rock phosphate, such as that from Minjingu in northern Tanzania, or agricultural lime for soil amendment purposes (rather than for use in poultry or livestock feed).

The survey included questions on how the dealers obtained their supplies of fertilizer.

- On average, 54 percent of the traders in the sample only used one supplier (58 percent of small-scale traders and 41 percent of large-scale), while only 12 percent used three or more suppliers (an equal percentage of small-scale and large-scale traders).
- Traders tend to obtain several small orders from their suppliers over a season, rather than single large orders. The median number of fertilizer orders that traders, both small-scale and large-scale, reported obtaining from their principal supplier in 2010 was five.
- In general, the traders are responsible for transport of the fertilizer ordered from the supplier to their business premises. Overall, only 15 percent of traders reported that their supplier delivered the fertilizer stocks—this was more common among large-scale traders, 29 percent of whom reported that the supplier arranged delivery. Small-scale traders tend to use public transport or their own transport means, while large-scale traders are more likely to hire truck transport (59 percent).
- For payment to suppliers, 37 percent of traders reported that they were able to obtain fertilizer stocks from their principal supplier on credit. The credit terms most commonly reported were a 50 percent down payment upon delivery with full payment due in either 14 days or two months. Large-scale traders were no more likely to obtain credit terms from their suppliers than were small-scale traders.

Table 4.5 provides information on the location of the principal supplier, as reported by the trader. Kampala is the most common place for fertilizer traders to obtain their stocks. However, there are differences by study area. As might be expected, small-scale traders outside of Kampala tend to go to local suppliers for their stocks if they do not go to Kampala. Large-scale traders go to Kampala, Mbale, or will import themselves from Kenya—mainly Nairobi, but also Kitale on the other side of Mount Elgon from Mbale. (Note that some small-scale traders also reported importing fertilizer from Kenya directly.)

Table 4.5—Location of principal fertilizer supply source, by percentage of fertilizer traders

Study area	All			Masaka			Kampala			Iganga			Mount Elgon		
Source of supply	Small Scale	Large Scale	All	Small Scale	Large Scale	All	Small Scale	Large Scale	All	Small Scale	Large Scale	All	Small Scale	Large Scale	All
Kampala	42	41	42	21	0	17	76	83	78	56	50	55	0	20	7
Masaka	22	0	16	79	0	61	0	0	0	0	0	0	0	0	0
Iganga	8	0	6	0	0	0	6	0	4	33	0	27	0	0	0
Mbale	16	24	18	0	50	11	6	0	4	0	0	0	70	40	60
Kenya	12	35	18	0	50	11	12	17	13	11	50	18	30	40	33
n	*50*	*17*	*67*	*14*	*4*	*18*	*17*	*6*	*23*	*9*	*2*	*11*	*10*	*5*	*15*

Source: Uganda fertilizer trader survey.

The survey included a question on whether the trader had experienced any problem with the quality of the fertilizer supplied by the principal supplier. The results show that the quality of the fertilizer they market is not a major concern for most traders. Only 9 of the 67 traders who responded to the question reported a problem. Three noted that they had received fertilizer that had a different color or consistency (for example, powder rather than granular) than expected, raising the suspicions of customers. Two reported obtaining expired fertilizer, and an equal number reported that the fertilizer (foliar fertilizer

in powder form) did not dissolve as expected. One trader reported short weight in bags obtained, while another reported stones in the fertilizer.

Costs to Traders of Acquiring Fertilizer

One module of the survey questionnaire asked traders to consider all of the costs incurred in obtaining an order from their principal supplier of fertilizer. These costs were standardized on the basis of cost per 50-kg bag and are reported in Table 4.6.[12]

Table 4.6—Breakdown of costs of obtaining fertilizer by trader

	Small Scale	Large Scale	All	*n*
Order size, 50-kg bags, median	30	350	50	*69*
Payment to supplier, USh/bag, median	78,000	59,800	70,000	*67*
Loading or offloading from vehicle, UShs/bag, median	200	200	200	*62*
Transport (all), UShs/bag, median	1,250	3,000	1,250	*55*
Transport from Nairobi to Kampala, UShs/bag, median	2,750	6,500	5,000	*9*
Transport from Kampala to Iganga or Masaka, UShs/bag, median	1,330	670	1,000	*9*
Transport in local area (for example, Masaka town supplier to Masaka area dealer), UShs/bag, median	1,000	750	1,000	*31*
Road fees (may be paid by transporter), UShs/bag, median	—	—	400	*7*
Border crossing fees (may be paid by transporter), UShs/bag, median	—	—	425	*4*
Clearing agent fees, UShs/bag, median	—	—	960	*6*

Source: Uganda fertilizer trader survey.

With regard to transport, some associated fees may or may not be covered as part of the overall costs of transport. These include road fees at roadblocks or weigh bridges. For importers from Kenya, border-crossing fees may be paid out of pocket by the trader, the transporter, or the clearing agent. Importers will also have to pay a clearing agent, who will handle the paperwork to clear the shipment at the border. All except two traders reported that they were able to arrange delivery from supplier to their business premises with a single transporter. These two traders imported their stock from Kenya. One had to use a second transporter to take the order from the border, the other from Kampala on to Masaka.

A set of questions also was asked on all other fees and taxes that a fertilizer trader might bear. The most commonly reported fee was an annual trading license fee, reported by 13 of the 70 traders in the sample. The amount the traders reported paying for this license ranged from UShs 15,000 to 250,000, with a median fee of UShs 100,000.

In designing this study, the issue was highlighted of fertilizer importers reportedly paying a 6 percent withholding tax on the value of their shipment, despite fertilizer being a zero-rated good upon which no tariff should be charged. However, none of the traders in the survey who imported fertilizer from Kenya reported paying any withholding tax.

[12] The costs of transport reported by the traders may not stand up to close validation. A transporter interviewed stated that the cost of transporting a 28-ton load of fertilizer from Nairobi to Kampala is KShs 190,000 (UShs 5,225,000) inclusive of any road and border crossing fees. The largest load that can legally be transported by road is 28 mt. This load cost corresponds to a 50-kg-bag cost of UShs 9,330, considerably more than what traders in our survey who brought fertilizer from Nairobi to Kampala reported.

Sales of Fertilizer

The survey captured information on the seasonality of fertilizer sales. The time period of the first rains is the most significant selling season—March especially, but with earlier sales in February in Kampala and Iganga and high sales extending into April in the Mount Elgon and Masaka areas. In Masaka, sales are significant at the start of the second rains in September. In the other three study areas, sales of fertilizer for the second rainy season, while significant, are seen to be less than for the first rainy season. Lowest sales occur in December and January in the Masaka, Iganga, and Mount Elgon study areas, while lowest sales for Kampala area traders occur from June to August.

The survey also covered the types of customers that the fertilizer traders served and the amount of fertilizer that each sort of customer would generally obtain in a single transaction. The aggregated responses to questions on the customers of the fertilizer traders in the sample are shown in Table 4.7.

Table 4.7—Breakdown of customers for fertilizer traders

		Small Scale	Large Scale	All
Other traders	**% all sales**	13.7	32.6	18.5
	Typical sale, 50-kg bag, mean	27.3	46.7	34.1
	median	7	20	10
Government, NGO, or other projects	**% all sales**	9.0	15.0	10.5
	Typical sale, 50-kg bag, mean	49.5	457.5	262.4
	median	30	75	50
Farmers groups	**% all sales**	11.0	8.3	10.3
	Typical sale, 50-kg bag, mean	10.3	15.1	12.2
	median	10	10	10
Individual farmers	**% all sales**	66.3	44.1	60.6
	Large-scale farmers, % all farmer customers	12.8	17.9	14.1
	Large-scale farmers, typical sale, 50-kg bag, mean	7.2	30.4	14.4
	median	5	10	6
	Small-scale farmers, typical sale, 50-kg bag, mean	1.5	1.8	1.6
	median	0.2	1	0.5
Own district customers	**% all sales**	72.9	63.4	70.4
Neighboring districts	**% all sales**	19.9	29.0	22.3
Elsewhere in Uganda	**% all sales**	5.7	7.6	6.2
Other country customers	**% all sales**	1.5	0.0	1.1

Source: Uganda fertilizer trader survey.

Finally, questions were asked on a set of miscellaneous issues.

- Most fertilizer traders—73 percent—are willing to offer credit to customers. However, most will require that the individual be proven as a good customer for one year or more. The terms of credit generally involve a 50 percent down payment with full payment made within one month. None reported charging interest or a higher price for sales of fertilizer on credit.
- Fertilizer is generally imported and marketed in 50-kg bags. However, this quantity of fertilizer may exceed the needs of many small farmers, or the cost of this amount of fertilizer may exceed their ability to pay. Traders were asked if they sold fertilizer to customers in smaller quantities. The majority of traders do so—92 percent of small-scale and 72 percent of large-scale traders. Sales of less than 50 kg account for an estimated 65 percent of the fertilizer sales of small-scale traders and 48 percent of large-scale traders. However, only

very few traders obtain prepacked smaller packets of fertilizer from their wholesaler—under 5 percent of the traders overall stocked such small packs. Most break 50-kg bags of fertilizer and either repack the fertilizer themselves into smaller standard-weight packets (49.2 percent of all traders) or simply sell it loose by weight (45.9 percent). The most common packet size into which traders repack fertilizer is 1 kg.

- Membership in the Uganda National Agro-input Dealers Association (UNADA) was reported among 84 percent of the fertilizer traders in the sample. Traders were asked to state the most important benefits they obtain in joining the association. Training on business management and on proper use of fertilizers were the benefits most commonly reported. More than 90 percent of current members planned to renew their membership.
- Thirty percent of traders in the sample reported obtaining commercial credit for their business. The principal reasons were to either expand or improve the business premises or to purchase stock. Most felt that the decision to obtain the loan was an appropriate business decision.
- Traders were asked how they obtain up-to-date information on fertilizer prices. Most simply contact their principal supplier, although 30 percent reported that they consult with fellow fertilizer traders to determine current prices.
- Virtually all of the traders will offer advice to farmers on the recommended use of fertilizer. However, the means by which traders themselves obtain this information is quite varied, and the quality of the information that they obtain is difficult to judge: 36 percent of traders stated that UNADA was their most important source of information, 28 percent said that their own farming experience was the most important basis upon which they gave advice, and 13 percent relied on information provided by their fertilizer supplier. Less than 10 percent reported the National Agricultural Advisory Services (NAADS) as being an important source of information on proper fertilizer use.
- Finally, a set of questions inquired about dealers' subjective expectations over the next three years with regard to the number of fertilizer suppliers in the market, the number of customers, and the relative size of their own fertilizer business. The traders in the sample are generally optimistic: 70 percent expect more suppliers in the market, 84 percent expect significantly more customers for their fertilizer, and 87 percent expect that their fertilizer business will grow over the next three years. When asked why they were optimistic about their prospects, the most common reason offered was that they are seeing increased efforts to sensitize farmers on the benefits of using fertilizers, and they expect increased fertilizer demand will follow.

5. SURVEY OF FARMERS IN AREAS WHERE FERTILIZER IS USED

The second source of primary quantitative survey information on fertilizer supply in Uganda for this study was obtained through a survey of farmers—the actors at the end of fertilizer importation and marketing chains in Uganda. Both fertilizer users and nonusers were included in our sample. In this section of the paper, we provide select findings from this farmer survey.

The four study areas from which the sample of farmers was chosen were the same as those used for the survey of fertilizer traders—Masaka, peri-urban Kampala, Iganga, and the western slopes of Mount Elgon. Four farming communities were randomly selected in subcounties of these study areas, which fertilizer traders and agricultural experts in the study areas identified as having greater use of fertilizer than the norm for the area. Lists of farmers were drawn up in each community. These lists were divided according to whether the farmers were known to use fertilizer or not. Eight fertilizer users and eight nonusers were then to be randomly selected from these twin lists for inclusion in the sample for the farmer survey. Because nonrandom judgments were made at several steps in the sample selection process, it would be erroneous to assume that the subsamples are closely representative of farmers who do or do not use fertilizer in the study areas. However, the comparisons that our data allows us to make between users and nonusers should be relatively robust.

Characteristics of Fertilizer Users and Nonusers

General characteristics of the farming households in the sample are presented in Table 5.1. While the sample was selected with an aim to split it equally into fertilizer users and nonusers, success was mixed in this regard. Fertilizer use among vegetable farmers in the peri-Kampala area was much higher than anticipated, with four out of five sample farmers using fertilizer. In contrast, in Masaka, somewhat more nonusers than users were interviewed.

While there are considerable differences in the demographic characteristics of households between study zones, the only significant differences observed between fertilizer users and nonusers are found in the sex and age of the household head. Households that use fertilizer on at least some of their crops tend to be headed by younger men. In terms of educational attainment of the household head, significant differences are present between fertilizer users and nonusers in the full sample for all three levels considered—any formal education, completion of primary school, and completion of secondary school. With regard to household asset ownership, the general trend is that fertilizer users tend to be better endowed. However, of the assets considered, the only statistically significant difference between fertilizer users and nonusers is ownership of bicycles or motorcycles. Levels of livestock ownership and the mean animal herd or flock sizes of fertilizer user and nonuser households are statistically quite similar in the full sample.

Table 5.1—Household characteristics, by fertilizer use

Study Area	ALL			Masaka			Kampala			Iganga			Mbale		
	Non-user	User	All	Non-user	User	All	Non-user	User	All	Non-user	User	All	Non-user	User	All
Fertilizer use, %	—	—	58.6	—	—	41.1	—	—	82.1	—	—	54.1	—	—	58.1
Demographic															
Female headed, %	39.5	18.0	26.9	39.5	30.0	35.6	16.7	12.7	13.4	46.4	12.1	27.9	41.9	20.9	29.7
Household head age, mean, year	46.1	41.6	43.5	49.3	43.6	46.9	41.4	39.6	40.0	41.6	40.6	41.1	47.7	43.3	45.2
Household size, mean	8.6	8.8	8.7	8.4	8.7	8.5	7.0	7.3	7.3	9.8	10.6	10.2	8.3	9.4	8.9
Full-time household farm workers, mean	2.5	2.2	2.3	3.0	2.9	3.0	2.7	1.8	2.0	2.2	2.7	2.5	1.9	2.0	1.9
Educational attainment of household head															
Any education, %	90.2	98.1	94.8	90.2	96.7	93.0	91.7	100	98.5	85.7	93.9	90.2	93.5	100	97.3
Finished primary school, %	54.5	69.6	63.3	53.7	53.3	53.5	58.3	75.5	72.3	50.0	75.8	63.9	58.1	69.0	64.4
Finished secondary school, %	7.1	17.1	13.0	7.3	13.3	9.9	8.3	17.0	15.4	7.1	9.1	8.2	6.5	26.2	17.8
Household assets															
House with cement mortared walls, %	52.6	59.0	56.4	51.2	56.7	53.4	66.7	76.4	74.6	75.0	75.8	75.4	29.0	25.6	27.0
Owns bicycle, %	55.3	67.1	62.2	69.8	86.7	76.7	91.7	65.5	70.1	71.4	97.0	85.2	6.5	32.6	21.6
Owns motorcycle, %	12.3	25.5	20.0	20.9	46.7	31.5	25.0	16.4	17.9	3.6	27.3	16.4	3.2	20.9	13.5
Owns motor vehicle, %	4.4	7.5	6.2	2.3	13.3	6.8	16.7	3.6	6.0	3.6	6.1	4.9	3.2	9.3	6.8
Owns any livestock, %	83.3	86.3	85.1	88.4	80.0	84.9	83.3	83.6	83.6	75.0	87.9	82.0	83.9	93.0	89.2
Cattle, herd size, mean	2.8	3.2	3.1	4.7	4.9	4.8	1.8	1.7	1.7	1.5	4.0	2.9	1.8	3.4	2.7
Goats, herd size, mean	2.6	2.2	2.3	4.0	2.4	3.3	1.0	1.3	1.3	1.8	3.5	2.7	1.9	2.1	2.0
Poultry, flock size, mean	16.5	24.3	21.1	29.3	28.1	28.8	18.9	32.5	30.1	9.3	22.5	16.4	4.5	12.4	9.1
n	*114*	*161*	*275*	*43*	*30*	*73*	*12*	*55*	*67*	*28*	*33*	*61*	*31*	*43*	*74*

Source: Uganda farmer survey.

Table 5.2 shows the difference in off-farm sources of income for the head of farming households in the sample, disaggregated by study area and fertilizer use and nonuse. Statistically significant differences between fertilizer users and nonusers are seen along several dimensions. Users are significantly more likely to engage in off-farm employment than are nonusers. Of those who do work off-farm, the type of work that fertilizer users engage in is more likely to be more highly paid skilled work than unskilled work or trading activities. Among off-farm workers, those who use fertilizer are significantly more likely to work off-farm for more months of the year than those who do not use fertilizer in their farming activities and to spend more days in those months working off-farm. Although differences appear across study areas, the average monthly income obtained when working off-farm is, in consequence, significantly higher for fertilizer users than for nonusers.

Table 5.2—Engagement in off-farm income-generating activities by household head, by fertilizer use and nonuse

Study area	ALL			Masaka			Kampala			Iganga			Mbale		
Fertilizer use	Non-user	User	All	Non-user	User	All	Non-user	User	All	Non-user	User	All	Non-user	User	All
Engage in off-farm work, %	24.6	45.3	36.7	25.6	36.7	30.1	25.0	29.1	28.4	25.0	51.5	39.3	22.6	67.4	48.6
Of those, engaged in unskilled work, %	25.9	21.1	22.4	45.5	27.3	36.4	33.3	33.3	33.3	0.0	31.3	21.7	16.7	6.9	8.6
Skilled work, %	18.5	36.6	31.6	0.0	27.3	13.6	0.0	13.3	11.1	57.1	31.3	39.1	16.7	55.2	48.6
Trade, %	55.6	42.3	45.9	54.5	45.5	50.0	66.7	53.3	55.6	42.9	37.5	39.1	66.7	37.9	42.9
Months per year engaged in off-farm work, mean	6.8	8.6	8.1	6.1	5.8	6.0	9.3	9.1	9.2	6.4	8.1	7.6	7.1	9.7	9.2
Workdays per month in off-farm work when engaged, mean	17.1	21.1	19.9	18.9	18.9	18.9	21.3	18.3	18.8	16.4	15.9	16.0	13.0	26.2	23.7
Off-farm income for those engaged, monthly UShs thousands, mean	139	276	239	183	170	177	116	207	192	97	253	207	129	368	139
UShs thousands, median	50	200	150	75	100	100	100	150	150	30	200	135	60	300	50
n	*114*	*161*	*275*	*43*	*30*	*73*	*12*	*55*	*67*	*28*	*33*	*61*	*31*	*43*	*74*

Source: Uganda farmer survey.

Finally, Table 5.3 provides descriptive statistics on the agricultural experience and aspects of the land that farmers in the study sample farm. Here again some significant differences are seen between fertilizer users and nonusers. In keeping with the earlier finding that nonusers tend to be older, nonusers also tend to be more experienced farmers on average. However, fertilizer users have somewhat larger farms than do nonusers, although the pattern is not consistent across study areas when looking at median farm size. No significant differences are observed in how the farmland was obtained across the entire sample, although in Iganga nonusers are more likely to have purchased their land, while in Mbale the reverse is true and users are more likely to have done so. Farmers were asked to provide a subjective assessment of the fertility and productivity of the soil on their farm when fertilizer is not used on it. As might be expected, no differences appear in the proportion of users and nonusers who characterize the soil quality as good, but a significantly larger proportion of fertilizer users characterized their soil as being of poor quality.

Table 5.3—Agricultural experience and farmland, by fertilizer use and nonuse

Study area	ALL			Masaka			Kampala			Iganga			Mbale		
Fertilizer use	Non-user	User	All	Non-user	User	All	Non-user	User	All	Non-user	User	All	Non-user	User	All
Farming experience: mean, years	23.7	18.4	20.6	27.1	22.3	25.1	16.6	16.4	16.4	17.4	13.8	15.5	27.5	21.6	24.1
median, years	20	19	20	22.5	20	20	16.5	15	15	16.5	12.5	15	30	22.5	25
Farm area: mean, ha	1.9	2.8	2.4	2.4	3.8	3.0	2.1	2.5	2.4	1.4	3.3	2.4	1.5	1.9	1.7
median, ha	1.2	1.6	1.6	1.6	1.6	1.6	0.8	1.6	1.2	1.2	2.4	1.6	1.2	1.2	1.2
Acquired most of land by purchase or rent, %	52.6	59.6	56.7	48.8	56.7	52.1	50.0	56.4	55.2	57.1	45.5	50.8	54.8	76.7	67.6
Characterizes general soil quality of farm as: poor, %	34.5	46.9	41.8	40.5	50.0	44.4	25.0	54.5	49.3	50.0	42.4	45.9	16.1	38.1	28.8
good, %	21.2	15.6	17.9	28.6	13.3	22.2	8.3	18.2	16.4	14.3	21.2	18.0	22.6	9.5	15.1
n	*114*	*161*	*275*	*43*	*30*	*73*	*12*	*55*	*67*	*28*	*33*	*61*	*31*	*43*	*74*

Source: Uganda farmer survey.

To further explore in a multivariate framework the farmer and farm-level determinants of fertilizer use in the study areas, a logistic maximum likelihood estimation approach was used to assess the relationship between several characteristics of the farming household and their farm and whether or not fertilizer is used. The results of this multivariate analysis are shown in Table 5.4. The results are presented as odds ratios rather than as coefficients.[13]

As shown earlier significant differences are observed between fertilizer users and nonusers for most of these determinants, but when these determinants are considered jointly in this multivariate model, only a handful remain statistically significant for fertilizer use. Determinants that are negatively associated with fertilizer use include the household head being a woman and the number of years the head of household has engaged in farming. Positive determinants of fertilizer use among farmer survey sample households are ownership of a motorcycle, involvement in off-farm work of a skilled nature, and a subjective assessment that quality of the soil farmed is poor. The other potential determinants investigated here are shown to be statistically insignificant.

While all evidence points to the importance, for example, for fertilizer-using farmers to have a remunerative off-farm employment source or a relatively good asset base, which this model confirms, it is also important to note that the pseudo-R^2 for the model is quite low at 0.159. Much of why farmers in the sample choose to use or not use fertilizer is unexplained by this model.

[13] The odds ratio is the chance of the dependent variable—fertilizer use by the farming household—changing from 0 to 1 (a positive outcome in statistical terms) as a result of a one-unit positive change in the independent variable. In contrast to regression-based models where a statistically insignificant coefficient is 0, a statistically insignificant odds ratio is 1—that is, a 1-to-1 or even chance. Odds ratios that are less than 1 represent an inverse relationship between the independent and dependent variable, while odds ratios greater than 1 represent a direct relationship.

Table 5.4—Multivariate logistic analysis of farmer and farm-level determinants of fertilizer use

Explanatory variables	Odds Ratio	Standard Error
Female household head (0/1)	0.230***	0.082
Household size, members	1.045	0.044
Full-time farm workers in household, number	1.016	0.099
Primary school—head completed (0/1)	1.206	0.372
Secondary school—head completed (0/1)	1.997	1.011
House has cement-mortared walls (0/1)	1.173	0.347
Owns motorcycle (0/1)	3.303***	1.410
Engages in skilled off-farm employment (0/1)	3.161**	1.803
Engages in trade off-farm (0/1)	0.641	0.268
Farming experience, years	0.972**	0.012
Land under crops, ha	1.014	0.060
Considers soil on farm to be poor (0/1)	1.926**	0.614
Considers soil on farm to be good (0/1)	0.995	0.414
Purchased or rents most of farmland (0/1)	1.366	0.397
Owns livestock (0/1)	1.446	0.568
n	*260*	
Pseudo-R^2	*0.159*	

Source: Uganda farmer survey.
Note: *** p < 0.01, ** p < 0.05, * p < 0.1.

Fertilizer Use on Crops

The farmer survey for this study focused on four crops on which fertilizer is sometimes used in the study areas—Robusta coffee, Arabica coffee, maize, and vegetables. Table 5.5 shows what proportion of the sample of farmers produces each crop, and of those farmers, what proportion uses fertilizer on the crop. Of the four crops, vegetables, if grown, are most likely to receive fertilizer. However, maize is more commonly grown and is frequently fertilized. Consequently, maize is the most fertilized of the four crops among the sample farmers.

Table 5.5—Maize, vegetables, Robusta coffee, and Arabica coffee, production of and use of fertilizer on crop by sample farmers

	ALL	Masaka	Kampala	Iganga	Mbale
Maize, %	77.8	80.8	50.7	98.4	82.4
Of whom use fertilizer, %	44.4	30.5	50.0	48.3	50.8
Vegetables, %	42.5	30.1	92.5	31.1	18.9
Of whom use fertilizer, %	65.0	31.8	79.0	47.4	78.6
Robusta coffee, %	34.9	72.6	28.4	39.3	0.0
Of whom use fertilizer, %	15.6	26.4	0.0	4.2	
Arabica coffee, %	22.5	0.0	0.0	3.3	81.1
Of whom use fertilizer, %	27.4			0.0	28.3
n	*275*	*73*	*67*	*61*	*74*

Source: Uganda farmer survey.

Table 5.6 contrasts the crop management of farmers according to whether they do or do not use fertilizer on the crop in question. In general, farmers who use fertilizer on a crop will have a larger area planted with that crop, are more likely to use commercial improved seed and pesticides, and are more likely to have hired labor to perform some of the off-farm crop operations during the course of the growing season or at harvest. Fertilizer users are not necessarily any less likely to use available organic resources (mulch or manure, in particular) for soil fertility management on the crop plot.

Table 5.6—Crop management characteristics, by crop and fertilizer use

Crop	Maize			Vegetables			Robusta coffee			Arabica coffee		
Fertilizer use	Non-user	User	All	Non-user	User	All	Non-user	User	All	Non-user	User	All
Area under crop, ha mean	0.61	1.05	0.80	0.32	0.51	0.44	0.72	2.06	0.93	0.49	0.80	0.58
Median	0.40	0.81	0.40	0.40	0.40	0.40	0.40	0.81	0.40	0.40	0.40	0.40
Commercial seed, %	45.4	80.0	60.7	43.9	72.4	62.4						
Organic materials used for soil fertility management, %	31.9	36.8	34.1	70.7	63.2	65.8	49.4	80.0	54.2	71.1	64.7	69.4
Commercial pesticide use, %	30.3	38.9	34.1	53.7	92.1	78.6	32.1	80.0	39.6	17.8	47.1	25.8
Labor hired for some off-farm crop operations, %	42.9	75.9	56.8	31.6	61.8	51.8	50.0	60.0	51.7	55.0	70.6	59.6

Source: Uganda farmer survey.

Some information on fertilizer use by sample farmers is presented in Table 5.7.[14] Farmers use quite high amounts of fertilizer for the coffee varieties. For maize and Robusta, the only crops for which yield increases could be computed, fertilizer use is judged to double or triple yields, based on farmer estimates of the yield they would have obtained had they not used fertilizer. The farmers using fertilizer in the sample were relatively confident about the profitability of fertilizer use on their crop: At the median, farmers felt that prices would have to drop by half for maize and the coffee varieties before they would call into question the economic wisdom of using fertilizer.

Table 5.7—Fertilizer use, by crop

	Maize	Vegetables	Robusta Coffee	Arabica Coffee
Principal fertilizers applied	DAP; Urea	Urea; DAP; 17:17:17; 25:5:5+5S	Urea; 17:17:17; CAN	CAN; 17:17:17; Urea
Fertilizer application rate, kg/ ha, median	125	90	165	370
Fertilized crop yield, kg/ha, median	1,850	—	560	—
Estimated unfertilized crop yield, kg/ha, median	620	—	250	—
Estimated fertilizer use efficiency, kg additional crop harvested per kg fertilizer applied, median	8.9	—	—	—
Price obtained for fertilized crop, UShs/kg, median	300	—	1,000	4,000
Estimated price under which farmer expects fertilizer use on crop would no longer be profitable, UShs/kg, median	150	—	600	2,000

Source: Uganda farmer survey.
Notes: CAN, calcium ammonium nitrate; DAP, diammonium phosphate.

[14] As considerable variance was seen in the data, only medians are presented here. Since several vegetables were grown with fertilizer, aggregate statistics could not be computed. The sample for fertilized Arabica coffee was too small to confidently estimate yields.

The most common vegetables to which fertilizer was applied by sample farmers were tomatoes, cabbage, and leafy green vegetables. The four crops considered in the survey were the principal crops to which fertilizer was applied in the study areas. However, Irish potatoes and upland rice were reported to be fertilized by a few sample farmers in the Mount Elgon and Iganga study areas, respectively.

Access to Fertilizer

Some characteristics of how the farmers in the study sample who use fertilizer obtain the input are presented in Table 5.8. Most farmers will purchase fertilizer twice in the course of a year. In Masaka, Iganga, and Mbale, there is a strong seasonal pattern in fertilizer purchase, with farmers making their largest purchase of fertilizer at the start of the first rainy season. In Kampala, as might be expected for vegetable producers, fertilizer purchases occur in most months of the year, with somewhat higher purchases at the start of both the first and second rains.

Table 5.8—Farmer access to fertilizer

	ALL	Masaka	Kampala	Iganga	Mbale
Fertilizer purchases in 2010, number, mean	2.5	2.2	3.4	1.9	2.3
Median	2	2	2	2	2
Month of largest purchase	Mar	Feb/Mar	Sept; Feb/Mar	Feb	Apr
Total fertilizer amount purchased in largest purchase, kg, mean	124.1	159.2	74.9	133.1	147.9
Median	50	45	30	50	100
Total fertilizer value purchased in largest purchase, UShs, mean	141,547	113,100	83,797	178,538	190,338
Median	67,500	42,500	60,000	87,500	95,000
n	*153*	*29*	*50*	*32*	*42*

Source: Uganda farmer survey.

Although some farmers purchase several bags of fertilizer at a time, the median amount purchased in the largest purchase reported by farmers was 50 kg of fertilizer—generally a single bag of a single type, but in some cases smaller amounts of two types of fertilizer. Table 5.9 presents by fertilizer type the amount and price of fertilizer purchased for those reporting having purchased the fertilizer as part of their largest purchase reported.

Table 5.9—Fertilizer purchases by farmers

	Purchase amount, kg		Price, UShs per 50-kg bag	
	Mean	Median	Mean	Median
Urea	86.5	50	88,400	80,000
Calcium Ammonium Nitrate (CAN)	240.4	100	91,400	85,000
Diammonium Phosphate (DAP)	73.5	50	90,400	90,000
17:17:17	80.9	45	87,700	88,000
25:5:5+5S	95.0	50	93,600	93,000

Source: Uganda farmer survey.

A series of questions was asked of farmers who purchased fertilizer. Virtually all farmers purchased fertilizer from traders. Only 8 of the 152 farmers in the sample that purchased fertilizer obtained it from sources other than traders—4 from nongovernmental organizations and 4 from farmers'

groups. Less than 10 percent of farmers ordered the fertilizer that they needed sometime before they acquired it—most purchased fertilizer from the stock of the trader. Of those that had to order, most collected the fertilizer the following day.

Less than 8 percent of the farmers who purchased fertilizer from a trader were able to do so on credit from the trader. Of those who did, most had been customers of the trader for at least two years. Payment in full was varied, with some traders expecting payments in one month, others in four months. Virtually all farmers who obtained credit reported that they did not have to pay any more for the fertilizer than if they had paid in cash. Thirteen percent of farmers who purchased fertilizer reported that they obtained credit from sources other than the trader in order to purchase their fertilizer. Of the 21 farmers in the sample reporting having done so, 3 obtained personal loans from family, 5 received personal loans from nonfamily members, 7 obtained commercial loans, and 5 reported obtaining a loan from a savings and credit cooperative.

Table 5.10 provides some indication of the proximity of sample farmers to fertilizer dealers. Just under half of the sample farmers who purchased fertilizer paid for transport of the fertilizer from the dealer to their farm. The other farmers carried it themselves on foot or on their own bicycle or motorcycle. Those who paid for transport generally either used a rented motorcycle or public transport (taxi bus). The median cost of transporting the fertilizer per kg per km for those sample farmers who paid for transport was UShs 6.30. However, the mean cost was considerably higher than this, particularly in the Kampala area, indicating that some farmers faced quite substantial costs in transporting their fertilizer to their farm.

Table 5.10—Transport of fertilizer from dealer to farm, and time from purchase to application

	ALL	Masaka	Kampala	Iganga	Mbale
Distance to fertilizer supplier from farm, km, mean	10.4	17.2	10.2	12.2	4.4
Median	6	6.4	8	10	3
Fertilizer transport cost from supplier to farm, UShs per kg per km, mean	29.4	18.8	60.4	20.8	9.8
Median	6.3	2.8	12.4	4.4	6.7
Time from fertilizer purchase to application, days, mean	8.2	14.2	5.8	7.3	7.0
Median	2	7	2	3	1
n	*149*	*28*	*50*	*31*	*40*

Source: Uganda farmer survey.

Most farmers obtain their fertilizer just before they apply it. The median time period between purchase and application across the sample of farmers who purchased fertilizer was two days. However, a sizable minority of farmers reported purchasing their fertilizer two weeks to one month in advance of application, with a small handful purchasing their fertilizer two months in advance.

Farmers were asked about the sources that they use to learn how best to use fertilizer on their crops. Farmers' groups were the most commonly mentioned source of such information, followed by the farmer's own experience, with their fertilizer supplier and the National Agricultural Advisory Services (NAADS) also being important sources of such information for some farmers.

With regard to NAADS, less than half of the farmers surveyed (42 percent) reported participating in NAADS activities. Of these, about three-quarters had received some guidance on fertilizer use through NAADS. Twenty of the farmers reported having received some fertilizer through NAADS mechanisms. A quarter of the surveyed farmers reported receiving information on fertilizer use from other organizations operating in their local areas, with about a quarter of these farmers having received some fertilizer in the past from these other organizations. The other organizations generally are nongovernmental agricultural development organizations that had or have projects in the areas where the survey was conducted.

6. DISCUSSION

The overall objective of this study was to investigate supply-side constraints to fertilizer use by smallholder famers in Uganda that are due in part either to government actions or to government inaction. The government actions that could constrain the supply of fertilizer include policies, regulations, or taxes that result in higher prices for fertilizer for smallholder farmers. Government inaction that could have a similar result is primarily in the area of missing investments in public goods that, were they in place, would reduce the cost or risks of using fertilizer for farmers.

The broad finding of this study is that the government of Uganda has taken some actions in the past that have generally been conducive to improving farmer access to fertilizer. The liberalization of agricultural markets, for both outputs and inputs, has increased private-sector participation in these markets, not only by importers and traders but also by commercially oriented smallholder farmers. Over the past 10 to 15 years, fertilizer importers and traders have seen a growing market for inorganic fertilizers among smallholders. These farmers seem to be finding that fertilizer use is profitable on certain crops, including maize, coffee, and vegetables, the particular crops examined in this study. Moreover, the relatively small margins that fertilizer importers and traders obtain from their trade in the product provide some evidence that a generally competitive market for the supply of fertilizers is now in place within Uganda.

However, this study also pointed to several areas where government inaction is having an adverse effect on efforts to increase agricultural productivity in Uganda through the increased use of inorganic fertilizer. The most important missing public goods are not specific to increasing smallholder adoption of inorganic fertilizer, but are implicated in broad efforts for increased economic growth in Uganda. Among these broader general initiatives that government must lead are improving transportation links to the world market, between markets within Uganda, and from farmers to local markets; expanding and strengthening agricultural, commercial, and import and export credit markets; and improving the flow of information on local, national, regional, and global market prices and prospects that farmers and traders need in order to make sound commercial decisions.

Nonetheless, as was noted in this paper, the government might work to put in place several fertilizer-specific initiatives if we are to see continuing increases in the use of fertilizer in Uganda by smallholders and higher levels of crop productivity nationally.

Overcoming Information Constraints

A lack of information in three areas—importing fertilizer to Uganda, proper use of fertilizer, and the economics of fertilizer use—results in either higher costs or inefficient use of inorganic fertilizer for smallholder farmers in Uganda. Regarding the first area, importation of fertilizer to Uganda, one of the principal motivations for the present study was to investigate why a 6 percent withholding tax charged on fertilizer imports by the Uganda Revenue Authority (URA) has been consistently reported. We found that as a zero-rated good, fertilizer should not be charged any tax or duty upon importation. Consequently, our URA informants stated that withholding tax, as an instrument to ensure tax compliance, should not be an element in the importation of fertilizer. The URA officers with oversight on this issue attributed the continued charging of withholding tax to clearing agents and importers not having the proper information on how fertilizer is treated by the URA. Moreover, the URA itself does not have systems in place to more proactively alert its agents or the clearing agents for the importers that withholding tax is not necessary on fertilizer imports. Much clearer information should be provided to all involved with fertilizer importation. Otherwise, the price of fertilizer that farmers face will be 6 percent higher than it needs to be, given the common pattern of importers simply paying what the clearing agents tell them to pay, passing the costs on to their fertilizer customers, and leaving it at that. The URA, the Ministry of Agriculture, Animal Industry, and Fisheries (MAAIF), and Uganda National Agro-input Dealers Association (UNADA) must all take responsibility for educating fertilizer importers and the clearing agents that importers employ on this information.

Second, farmers have very limited scientific information on the proper agronomic use of fertilizer on their crops within the particular agroecological conditions under which they farm. Farmers and traders surveyed for this study reported that farmers use fertilizer in a quite uninformed manner. Farmers continued to use the same fertilizers that they had used in the past on their crops, with little consideration of whether those fertilizers were the best choice for overcoming any crop nutrient deficiencies in the soil on which they planted. To increase agricultural production in Uganda through the use of modern production technologies, knowledge is needed on the proper application of these technologies, including for inorganic fertilizer. Farmers and those who advise them need to know about nutrient limitations and the use of fertilizer in response, for a particular agroecological zone and crop. For example, nitrogen or potassium is typically a limiting nutrient, and farmers need to know how those nutrient limitations can best be addressed using fertilizers as part of a comprehensive soil fertility management approach. Both the agricultural advisory services currently offered to farmers and syntheses of past research results on fertilizer response in the main crops grown in Uganda are very limited.

In a review of the Uganda fertilizer market, Tukacungurwa (1994) presents blanket fertilizer recommendation rates, by crop, which were published in the *Crop Production Handbook* of the Ministry of Agriculture and Forestry in 1985. It is unclear what sort of data (soil chemistry analysis, on-station fertilizer trials, on-farm fertilizer demonstration, or a combination) and what sort of analysis (agronomic or economic) were used as the basis for these recommendations. However, farmers require such recommendations. A research effort is now underway to develop area-specific fertilizer recommendations based on on-farm trials and demonstrations and a thorough review of the literature. This effort is led by soil scientists from the National Agricultural Research Laboratories at Kawanda Agricultural Research Institute with funding from the Alliance for a Green Revolution in Africa (AGRA). Such agricultural research must continue to receive strong support by MAAIF and the National Agricultural Advisory Services (NAADS), with clear expectations on the part of the scientists involved that their findings should be rigorously assessed and, thereafter, disseminated widely.

Fertilizer recommendations are generally developed primarily based on economic analysis of fertilizer response and not solely based on consideration of the agronomic response observed in fertilizer trials and demonstrations. As such, the third important information gap with regard to fertilizer use in Uganda has to do with the economics of fertilizer use on the various crops grown by smallholder farmers. Few farmers have access to this sort of information or know how they themselves might determine whether fertilizer use will be profitable on their own farms. In its simplest form, such an analysis takes into account the full cost of fertilizer, the likely yield response the farmer will obtain from the use of fertilizer, and the returns that the farmer can expect to receive from the sale of the fertilized crop in local output markets. The AGRA-funded effort based at Kawanda seeks to do this. The efforts of these scientists should be the start of a regular and ongoing program of research to compile and disseminate a consistent and robust set of crop- and area-specific fertilizer recommendations. These recommendations need to be adaptable for changing market price conditions both for fertilizer and for the fertilized crops. They also should be able to be used appropriately by resource-constrained farmers who need to choose which elements of a recommended fertilizer application package they should prioritize in their farming practices.

Regulatory Reform

In Section 3 of this paper, on the legislation in place to regulate the importation and marketing of inorganic fertilizer, we suggested that the agrochemical regulations now in place are a poor fit for the public benefits sought through the regulations— at least for the standard, high-analysis fertilizers that are most commonly used in Uganda. A considerably lighter regulatory regime would allow more high-analysis fertilizer onto the Uganda market, resulting in lower costs for Ugandan farmers. The Ministry of Agriculture has drafted proposed new regulations that treat inorganic fertilizers in a less-restrictive manner than other agrochemicals. This effort to revise the regulations for inorganic fertilizers must be supported and completed. However, the current draft regulations for inorganic fertilizer can be improved

considerably, and many sections should be redrafted and discussed before they are submitted to the minister of agriculture for his assent.

On this issue, MAAIF, as the regulatory agency responsible for oversight on fertilizer importation and trade, should partner more closely with the Uganda National Bureau of Standards (UNBS) for both analytical and monitoring functions related to the marketing of inorganic fertilizer. This does not imply any duplication of functions across both agencies with regard to inorganic fertilizer: It is well within the expertise of the UNBS to provide oversight on the quality of high-analysis fertilizers imported and traded in Uganda, freeing MAAIF agricultural inspectors to turn their attention to other issues for which they have the unique expertise within government.

Direct Interventions by Government to Promote Fertilizer Use

Finally, in public debate over the past several years on how Uganda might best increase agricultural productivity and maintain a vibrant agricultural sector to reduce rural poverty, the government has been called upon regularly to directly intervene to reduce the price of fertilizers for farmers through some form of subsidy. The Farm Input Subsidy Program in Malawi is often held as a model for emulation. The perspective that we have gained from this study is that the government of Uganda should be cautious in its support for such calls, for several reasons:

- Fertilizer demand is principally derived from the significant profits that farmers judge that they can achieve through the sale of the extra harvest provided via the use of fertilizer. These profits are directly related to, among other things, the price they obtain in crop output markets. Although this study has focused primarily on constraints to fertilizer supply in Uganda, the economics of fertilizer use stems from the level of crop output prices that farmers receive and the reliability of those prices from year to year. Ugandan farmers need efficient and reliable output markets as the foundation for effective, profitable use of improved agricultural technologies, including inorganic fertilizer. In the absence of strong national and regional crop output markets, large subsidies on fertilizer in an effort to massively increase crop production in the country are likely to result in an exacerbation of gluts on the market for the fertilized crops and nonremunerative prices for those crops.
- However, a "starter-pack" approach to increase knowledge among Ugandan smallholders is a more reasonable avenue for government to pursue—that is, provision of subsidized small packets of improved seed and fertilizer to farmers to enable them to experiment and gain confidence in the appropriate use of fertilizer. However, this approach must be built on good and comprehensive information of patterns of crop yield response to fertilizer across Uganda. Existing information on these patterns needs to be synthesized before the government invests heavily in such an approach.
- Existing mechanisms for increasing fertilizer use by farmers need to be fully exploited before launching new efforts. Most notably, NAADS should promote fertilizer use among its farmer groups by providing the information farmers need on making profitable use of the input. Demonstration plots (with data collection on crop yield response to fertilizer on those plots) or the starter-pack approach could be an element of such efforts by NAADS.
- Finally, policymakers need to be clear on the objectives they seek to achieve by investing substantial public resources in fertilizer subsidies. The food security imperative that motivates the input subsidy program in Malawi is not so strong an argument in the context of Uganda, where the country is generally food secure in the aggregate, regularly exporting food to its neighbors. The high fertilizer prices that Uganda faces also seem not to be a result of market failure, for which a government subsidy might motivate corrective action, but a result of Uganda's location with regard to international fertilizer sources and relatively poor transportation links to those sources.

To conclude, over the past several decades, Uganda has been maintaining sufficient agricultural production to meet the needs of its growing population by expanding the amount of arable land put into production. However, there is clearly need for intensification of agricultural production in several areas of the country where the population density has risen to levels that make it difficult for sufficient production to be generated from existing cropland using traditional production methods. The government of Uganda must pay closer attention to how it can enable smallholder farmers to profitably and appropriately make use of inorganic fertilizer, improved seeds and planting materials, and other improved agricultural technologies for higher agricultural production by smallholders. Paying attention to supply-side factors related to the use of inorganic fertilizer and the other technologies is an important element of such efforts.

However, this is not an obvious or easy task to undertake. A considerable amount of land in northern Uganda remains arable but is not cropped. Profitable production on this relatively fertile land can be undertaken with much lower output crop prices than can be obtained on plots with depleted soil fertility that require fertilizer and other soil fertility management efforts in the more densely populated areas of rural Uganda. As such, stronger economic incentives exist for farmers to open such unfarmed land rather than to intensify production on existing fields by using fertilizers. The integration of Uganda's agricultural markets in part explains why fertilizer use is such a difficult economic proposition for Uganda's smallholders, even in densely populated areas. However, a few opportunities are available to exploit. It is clear that fertilizer use on exported cash crops, the local price of which is derived from international markets, and on vegetables in peri-urban areas of the country can be profitable. Also fertilizer use on maize, which is commonly sold in regional markets where prices are not so strongly correlated with local seasonal production conditions, seems to be economically rewarding for farmers. These production opportunities offer openings for the government of Uganda to increase the knowledge of farmers on the benefits of fertilizer use on their crops, thereby increasing demand to be met by a free-flowing fertilizer supply importation, distribution, and marketing chain, the investigation of which has been the focus of this study.

APPENDIX: INORGANIC FERTILIZER PRODUCTION POSSIBILITIES IN UGANDA

In discussions on inorganic fertilizer use in Uganda and the options for increasing crop productivity through the use of the input, a recurrent theme is whether Uganda might engage in domestic production of inorganic fertilizers. The Sukulu Hills rock phosphate deposit a few kilometers south of Malaba and Tororo along the Uganda–Kenya border is estimated to contain more than 200 million tons of phosphate rock with an average phosphate content of 12.8 percent P_2O_5. The Busumbu Hill deposit approximately 30 kilometers north of Tororo in the same area is estimated to contain 8.5 million tons total—3 million tons with an average content of 11.0 percent P_2O_5 and 5.5 million tons with an average content of 15.0 percent P_2O_5 (van Straaten 2002, 301–305). Out of the Sukulu deposit, Tororo Industrial Chemicals and Fertilizers, Ltd., produced 160,000 tons of phosphate fertilizers, primarily single superphosphate (SSP). This production occurred from 1962 to 1978, when operations were suspended due to lack of foreign exchange to purchase sulfuric acid for the industrial processing of the rock into SSP (Tukacungurwa 1994). The fertilizer factory at Sukulu was destroyed in the years that followed.

Any decision to invest in the domestic production of phosphate fertilizer would be faced with several challenges. Information on the agronomic response of the principal cash and staple food crops to the application of phosphate fertilizers is not readily available. While some research has been conducted, the results have not been compiled in a manner to allow a ready appreciation of the significance of phosphate deficiency as a constraint on higher crop production in Uganda. Thus, assessing the benefits of investing in domestic phosphate fertilizer production will be challenging. Agronomic testing has been done on the direct application of phosphate rock from both the Sukulu and Busumbu deposits with rather disappointing results obtained, particularly on acid soils. Better results are obtained when the phosphate rock is blended in about a 2:1 ratio with triple superphosphate fertilizer (van Straaten 2002). However, clearly any exploitation of these domestic phosphate rock deposits will require some sort of industrial beneficiation to enhance the agronomic availability of the phosphate.

The exploitation of phosphate deposits has been of recurring interest for mineral and agricultural development in Uganda for many decades, but only recently with the discovery of commercial oil deposits in the Albertine Rift of western Uganda has the domestic production of nitrogenous fertilizers been considered. Total oil reserves are believed to be 2 billion barrels, with recoverable reserves estimated at 0.8–1.2 billion barrels. The principal requirement for the production of nitrogenous fertilizer is energy, since the nitrogen is freely obtained from the atmosphere. However, the Haber–Bosch process used for nitrogen fertilizer production is a high-pressure and high-temperature process that is characterized by significant economies of scale. A nitrogen fertilizer production complex requires a start-up investment of more than $500 million. To be profitable, minimum production levels from such factories are 1,500 tons per day (Gregory and Bumb 2006). Recall that annual imports of all fertilizers into Uganda in 2010 were about 40,000 tons, or about one month's production from a smaller nitrogen fertilizer factory. The high cost associated with developing such factories and the large market necessary for a factory to operate profitably means that a close assessment must be made of the economics of nitrogen fertilizer production in the context of Uganda and the wider region that such a factory might supply.

In summary, although technically Uganda could be a producer of both phosphate and nitrogen fertilizers, current demand is likely insufficient for profitable returns to be obtained from investments in the industry. However, with expansion of demand both in Uganda and in the wider region, in time, sufficient scales of production might be obtained for profitable operation. Given the changing domestic and regional economy, the economics of the use of these domestic resources for inorganic fertilizer production should be regularly assessed.

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IFPRI HEADQUARTERS
2033 K Street, NW
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Fax: +1-202-467-4439
Email: ifpri@cgiar.org

IFPRI ADDIS ABABA
P. O. Box 5689
Addis Ababa, Ethiopia
Tel.: + 251 (0) 11-617-2500
Fax: + 251 (0) 11-646-2927
Email: ifpri-addisababa@cgiar.org