

Promoting Competition in the Fertilizer Industry in Africa

A Global and Local Approach

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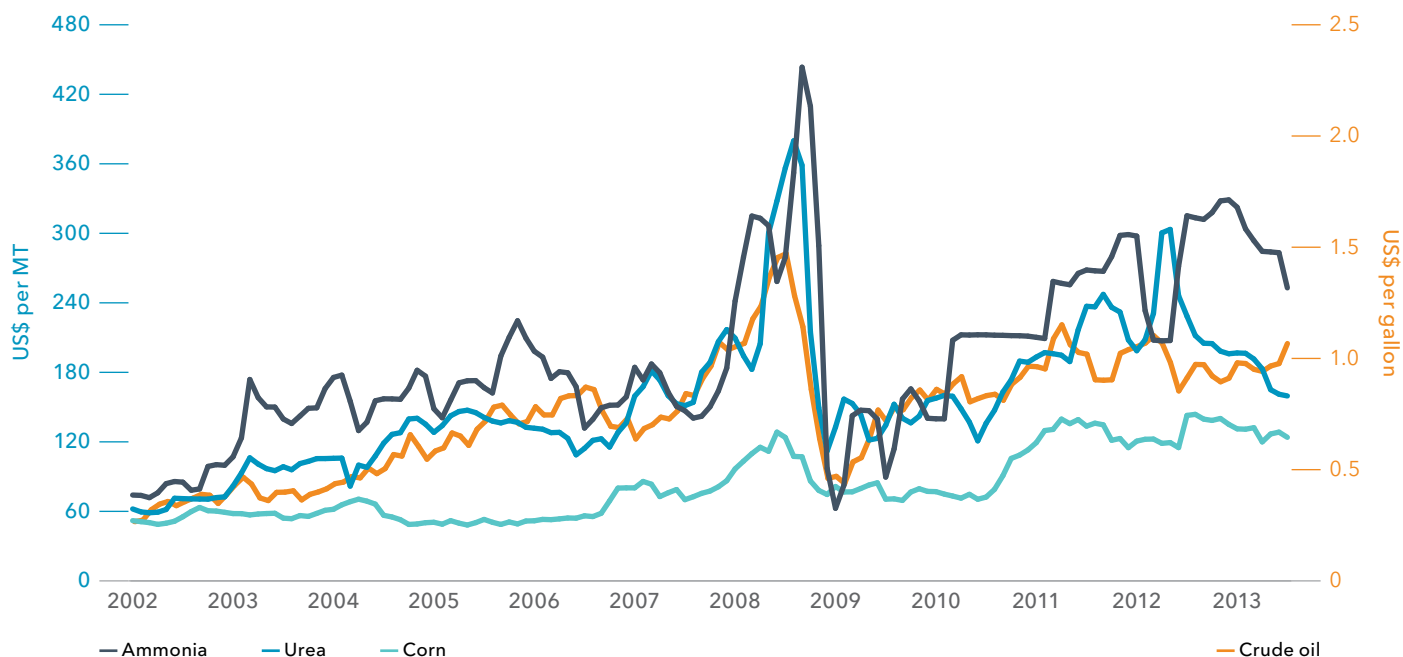
Agricultural productivity is lagging in some developing regions, including Africa south of the Sahara. Productivity in these regions suffers in part due to the low adoption of improved land management practices, including adequate fertilizer use. Those countries that have successfully increased their agricultural productivity have also considerably increased their use of fertilizer.¹ But in Africa south of the Sahara, fertilizer application rates average just 10 kilograms (kg) of nutrients per hectare (ha) of arable land, compared to 86 kg/ha in South Asia, 118 kg/ha in Latin America, and 198 kg/ha in an average middle-income country.² Given the central role that agriculture plays in the rural economy of Africa, several countries have implemented supply- and demand-driven policies and programs to promote sustainable fertilizer use, with mixed results. However, not much has been said about the market structure or competitive behavior along the supply chain in the highly concentrated fertilizer industry, nor about how this affects fertilizer uptake in the region. Globally, the industry has only a few producers, and African countries are highly and increasingly dependent on imported fertilizer. Locally, fertilizer distribution channels are also characterized by a limited number of market actors, often with a poor dealer network.

The fertilizer industry's high levels of concentration result both from its high requirements for raw materials such as nitrogen, phosphate, and potash, which are not available worldwide, and from economies of scale in production, which generate cost efficiencies for firms (that is, they lower the per-unit costs of production). However, high levels of concentration in an industry can

also create potential for exertion of market power and tacit collusion among firms, to the detriment of farmers. For example, the concentration of market power may allow a few companies to take full advantage of international price spikes in energy and grain markets, raising costs for farmers. During the 2008 food crisis, when oil and agricultural prices drastically increased, ammonia and urea prices exhibited even higher price spikes (Figure 1). By mid-2008, when the crisis was at its peak, ammonia and urea prices were two to three times higher than in mid-2007; oil and corn prices were 1.5 to 1.9 times higher. Other fertilizer products, including diammonium phosphate/monoammonium phosphate (DAP/MAP) and potash, exhibited similar price increases during that period. This suggests that the negative effects of market power on fertilizer prices may outweigh the benefits of cost efficiency in this highly concentrated market. Industry reports further indicate that leading fertilizer producers have enjoyed record profits in recent years, with combined total revenues of over US\$50 billion per year.³

Fertilizer sold in Africa south of the Sahara is the most expensive in the world, being roughly four times more expensive than it is in Europe. In addition to higher marketing costs related to regional and national supply-side constraints, which include the lack of adequate infrastructure and market information and limited access to credit, African farmers may be facing high input prices resulting from market power exertion.⁴ Ignoring this issue prevents a full understanding of the industry supply chain and could limit the effectiveness of policies designed to promote the development

Figure 1 Real monthly ammonia, urea, corn, and crude oil prices, 2002-2013



Source: Green Markets (www.fertilizerpricing.com); US Energy Information Administration (www.eia.gov); and FAOSTAT (www.fao.org/faostat/en/#home).

Note: Prices deflated by CPI, 1982-1984=100. The prices correspond to Ammonia US Gulf barge, Urea US Gulf prill import, No. 2 yellow corn FOB US Gulf, and Oklahoma crude oil FOB spot price. MT = metric tons.

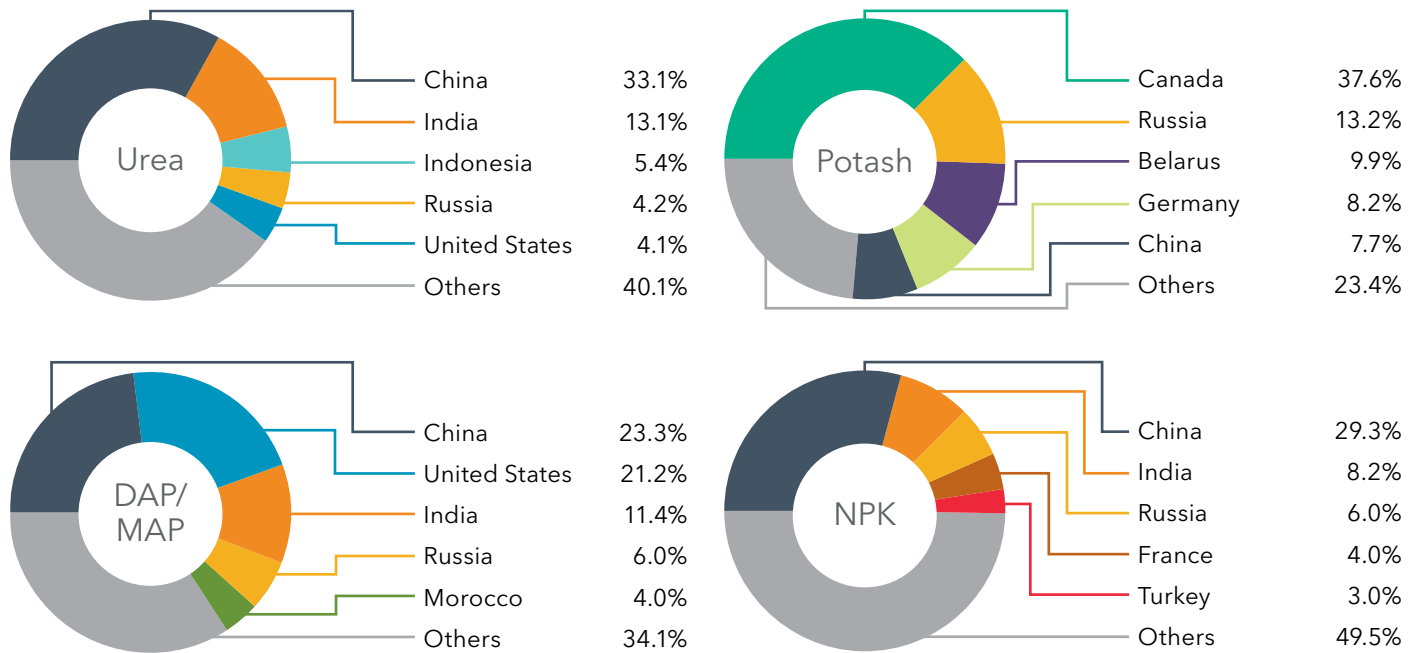
of input markets in Africa. This brief examines the potential impact of increased competition in the fertilizer industry on prices, using both global and local assessments as well as a simulated scenario of increasing competition in the region.

HIGH GLOBAL AND COUNTRY-LEVEL CONCENTRATION

The fertilizer industry is highly concentrated among a few countries that control most of the production capacity for the primary nitrogen, phosphate, and potash fertilizers.⁵ Five countries control more than half of the world's production capacity for urea (a nitrogen-based fertilizer), DAP/MAP (phosphate-based fertilizers), potash, and NPK (complex fertilizers) (Figure 2). In the case of potash, the top countries housed more than 77 percent of global production capacity in 2008/2009, with Canada and Russia alone responsible for more than half. In the case of urea and DAP/MAP, China, the United States, India, and Russia dominate production capacity. This geographic pattern of fertilizer production is largely determined by the availability of raw materials across the globe.

Similarly, the industry is highly concentrated within each of the main producing countries, with the exception of China, in part as a result of the potential for economies of scale in production and the large up-front investments required. Figure 3 illustrates the top-four concentration ratio—that is, the sum of market shares of the four largest producers in a market—for urea, DAP/MAP, potash, and NPK within each of the five major producing countries. In most cases, the top four firms control more than half of each country's production capacity. Concentration of potash production at the country level is the most extreme case: in four of the five main potash-producing countries, the top four firms account for all production capacity. For DAP/MAP and NPK, four of the five main producing countries show a top-four concentration ratio above 60 percent, while for urea three countries show a concentration ratio above 50 percent. In some cases, only one company operates in the country—for example, Belaruskali in Belarus and K+S KALI GmbH in Germany for potash, and OCP Group in Morocco for DAP/MAP.

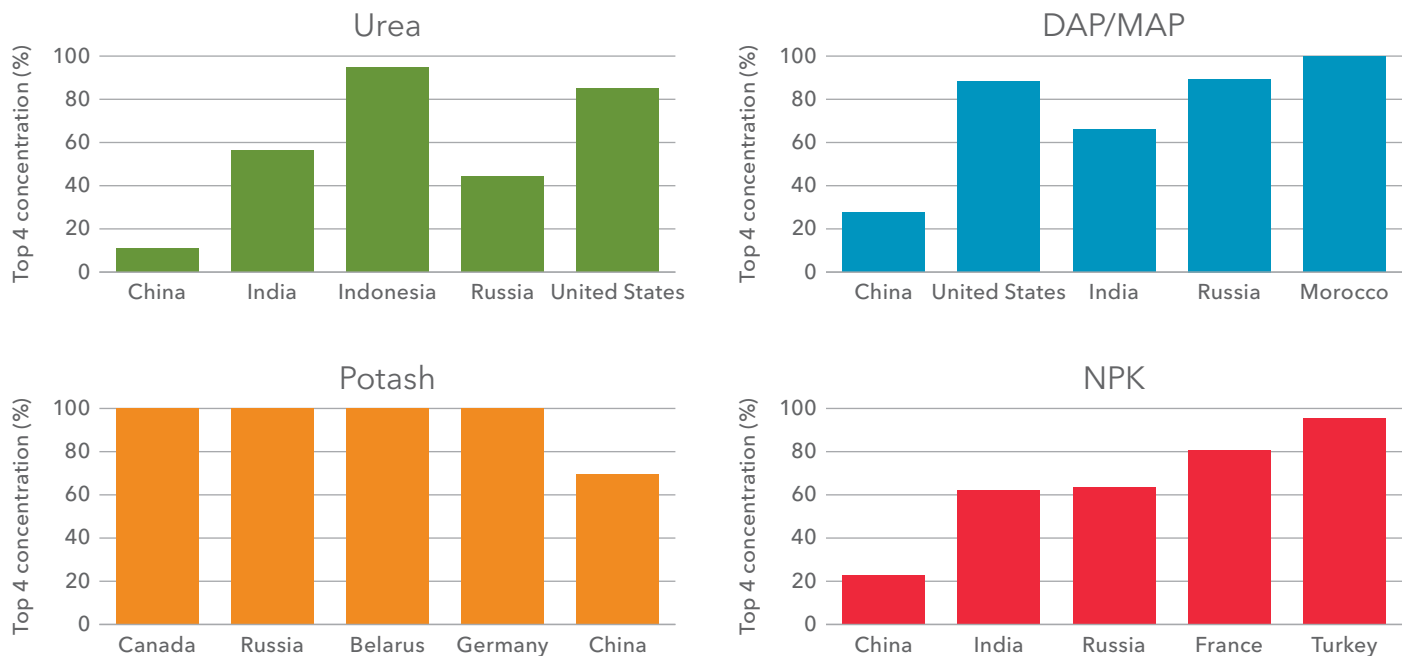
Figure 2 Distribution of world fertilizer production capacity (%) by country, 2008/2009



Source: IFDC (International Fertilizer Development Center), Worldwide Capacity Listings by Plant, Several Fertilizer Products (Muscle Shoals, AL: 2009).

Note: Based on capacity of operative plants in 2008/2009. DAP/MAP = diammonium phosphate/monoammonium phosphate. NPK = complex fertilizer (nitrogen, phosphorus, potassium).

Figure 3 Fertilizer production capacity of top four firms in main producing countries, 2008/2009



Source: IFDC (International Fertilizer Development Center), Worldwide Capacity Listings by Plant, Several Fertilizer Products (Muscle Shoals, AL: 2009).

Note: Based on capacity of operative plants in 2008/2009. DAP/MAP = diammonium phosphate/monoammonium phosphate. NPK = complex fertilizer (nitrogen, phosphorus, potassium).

Table 1 Impact on prices of a 10 percent decrease in concentration

Market share measure	Top-four concentration ratio	Herfindahl-Hirschman Index
Based on production capacity	-8.2%*	-5.6%
Based on number of plants	-11.6%*	-9.2%*

Source: M. A. Hernandez and M. Torero, "Market Concentration and Pricing Behavior in the Fertilizer Industry: A Global Approach," *Agricultural Economics* 44, no. 6 (2013): 723-734.

Note: The symbol (*) indicates if the simulated change is statistically significant with a 95 percent confidence level.

INCREASING COMPETITION AT THE GLOBAL LEVEL

The high levels of concentration observed in the fertilizer industry require policy makers to assess whether promoting competition in these markets would decrease prices, given that market power effects may be outweighing the cost-efficiency effects in the industry. On this matter, a study by Hernandez and Torero formally analyzes the relationship between fertilizer (urea) prices and market concentration using annual data from a panel of 38 countries.⁶ The panel nature of the dataset provides an opportunity to use differences in market structure across countries and time to determine if a positive correlation exists between prices and market concentration, while controlling for other potential factors—essentially, cost factors—that may also explain prices.

The two standard measures of market concentration used in the study are the top-four concentration ratio and the Herfindahl-Hirschman Index (HHI). The HHI is the sum of the squared market shares of each firm operating in a market. The market shares are measured in terms of both production capacity (in metric tons [MT]) and number of plants. Both the top-four concentration ratio and the HHI range from zero to one; increases in these indices indicate a decrease in competition (and a potential increase in market power), whereas decreases indicate an increase in competition. The main difference between the two indices is that the HHI places more weight on larger firms.

The analysis reveals a negative correlation between prices and market competition—higher prices are

correlated with greater industry concentration. Table 1 shows the estimated change in prices caused by a simulated 10 percent decrease in the level of concentration in the industry, using the top-four concentration ratio and the HHI for both fertilizer production capacity and number of fertilizer plants. A 10 percent decrease in the top-four concentration ratio based on production capacity leads to an average 8.2 percent decrease in fertilizer prices, whereas a 10 percent decrease in the top-four concentration ratio based on number of plants leads to an 11.6 percent decrease in prices. In the case of the HHI, a 10 percent decrease based on production capacity leads to a 5.6 percent decrease in prices, and using the number of plants, to a 9.2 percent decrease in prices, although the former change is not statistically significant at conventional levels.

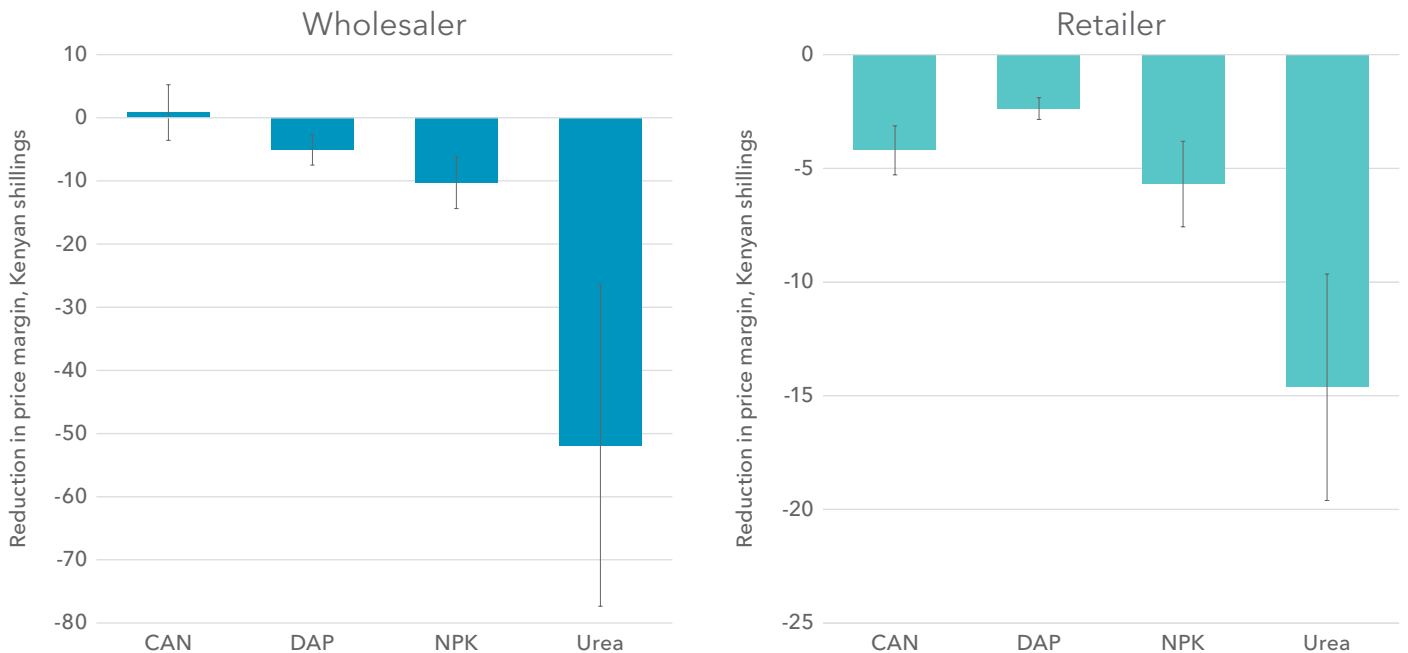
INCREASING COMPETITION AT THE LOCAL LEVEL: THE CASE OF KENYA

Data collected in 2016 through interviews with wholesalers and retailers in major market centers in Kenya’s Central region, Nairobi, Nyanza, Rift Valley, and Western region provide the basis for a similar preliminary assessment of the correlation between market concentration and prices in local distribution channels.* Information on prices, volume traded, costs, and company characteristics was gathered and combined with county-level characteristics from secondary data sources. The cross-sectional nature of the dataset allows us to make use of variations in market structure across locations to approximate the correlation between the number of competitors and the wholesale and retail price margins (that is, the difference between sale price and purchase price), controlling for other factors.

Like the global assessment, the Kenya analysis suggests a negative correlation between market competition and price margins for different fertilizer products commercialized at the wholesale and

* This work was carried out for the project on "Improving the Effectiveness of Policies and Strategic Investments in the Fertilizer Supply Chain for Some African Countries Taking into Account the Global and Country Level Market Structure and Constraints," funded by the European Commission, which concluded in December 2017. Researchers interviewed a total of 160 wholesalers and 340 retailers in Kiambu, Kirinyaga, and Nyeri (Central region); Nairobi; Kisii, Migori, and Nyamira (Nyanza); Bomet, Elgeyo Marakwet, Kericho, Laikipia, Nakuru, Nandi, Trans Nzoia, and Uasin Gishu (Rift Valley); and Bungoma, Busia, and Kakamega (Western region).

Figure 4 Decrease in wholesale and retail price margins per additional trader operating in the area



Source: Authors' calculations.

Note: The vertical lines represent 95 percent confidence intervals. CAN = Calcium ammonium nitrate. DAP = Diammonium phosphate. NPK = complex fertilizer (nitrogen, phosphorous, potassium).

retail level. The case of urea is the most noteworthy (Figure 4). Preliminary results suggest that one additional *wholesaler* operating in an area is associated with a 50 Kenyan shilling (US\$0.50) decrease in the wholesale price margin, a drop of 17 percent; and one additional *retailer* operating in the area is associated with a 15 Kenyan shilling (US\$0.15) decrease in the retail price margin, a decrease of 5 percent. Most of the other products also exhibit a decrease in price margins when more competitors operate in the market, although the change is much smaller. Overall, these results call for a closer look at the possibility of market power exertion across local distribution channels in the region.

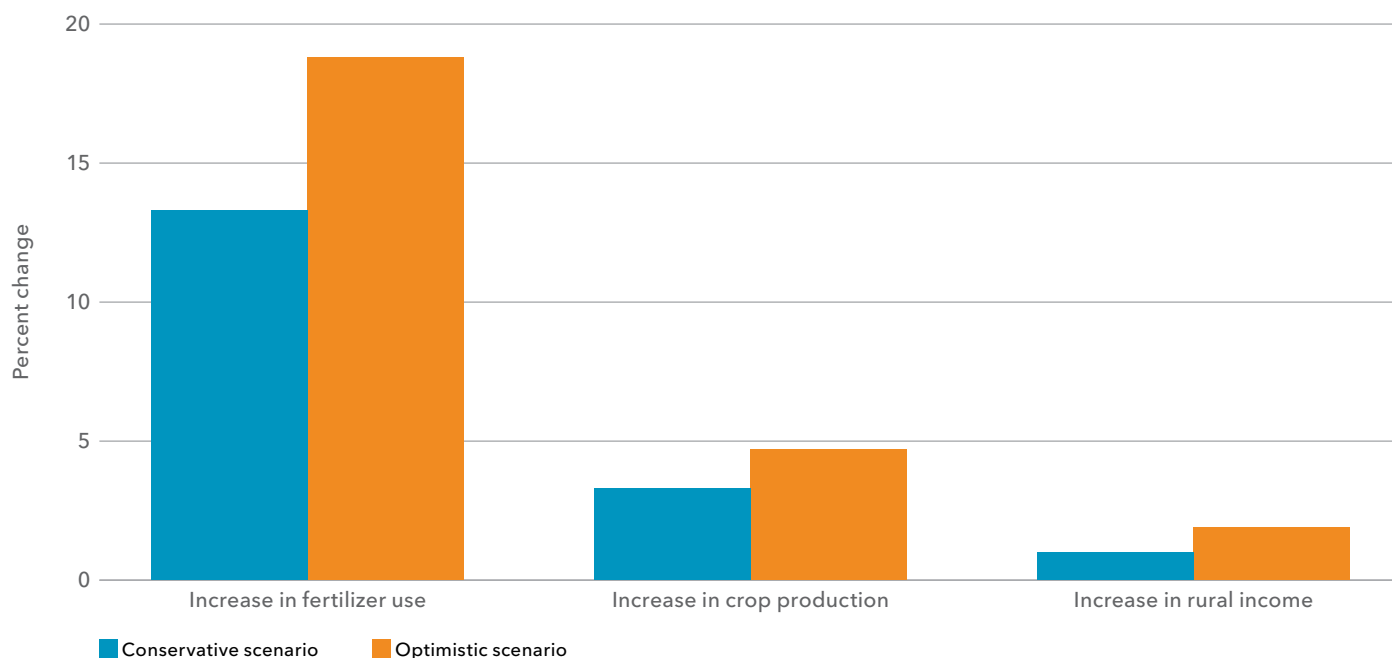
A REGIONAL SIMULATION

Based on the global analysis, we consider an 8.2 percent decrease in fertilizer prices after a 10 percent increase in competition to be a conservative scenario, while an 11.6 percent price decrease can be regarded as an optimistic scenario. By further assuming an elasticity of fertilizer use to prices of -1.6 and an elasticity of crop production to fertilizer use of 0.25 , the impact of increased

competition on both fertilizer uptake and crop production can be approximated.⁷ The simulation shows that a 10 percent increase in competition in the industry would increase fertilizer use by 13 to 19 percent and crop production by 3 to 5 percent (Figure 5). Considering that the share of crop sales in rural income is roughly between 30 and 40 percent in some developing regions such as Africa south of the Sahara, rural income would ultimately increase by 1 to 2 percent.

Based on these impacts, a cost-benefit analysis of a 10 percent increase in competition can be performed using Ghana, Kenya, Senegal, and Tanzania as examples. To decrease the top-four concentration ratio in Africa by 10 percent, it would be necessary to build a fertilizer (nitrogen) plant in the region with an annual production capacity of 0.7 million MT. This volume of production is equivalent to 10 percent of the annual production capacity already reported by the top four firms in the region.⁸ The new plant would absorb the share reduction of the top four firms in the market but would not be large enough to be among the top four producers. The following cost and income assumptions of these estimates should also be taken into account:

Figure 5 Impact on fertilizer use, crop production, and rural income of a 10 percent decrease in industry concentration



Source: M. A. Hernandez and M. Torero, "Market Concentration and Pricing Behavior in the Fertilizer Industry: A Global Approach," *Agricultural Economics* 44, no. 6 (2013): 723-734; P. Gruhn, F. Goletti, and R. N. Roy, *Proceedings of the IFPRI/FAO Workshop on Plant Nutrient Management, Food Security and Sustainable Agriculture: The Future through 2020* (Viterbo, Italy, May 16-17, 1995); B. L. Bumb, M. E. Johnson, and P. A. Fuentes, "Policy Options for Improving Regional Fertilizer Markets in West Africa," IFPRI Discussion Paper 1084 (Washington, DC: IFPRI, 2011).

COST ASSUMPTIONS:

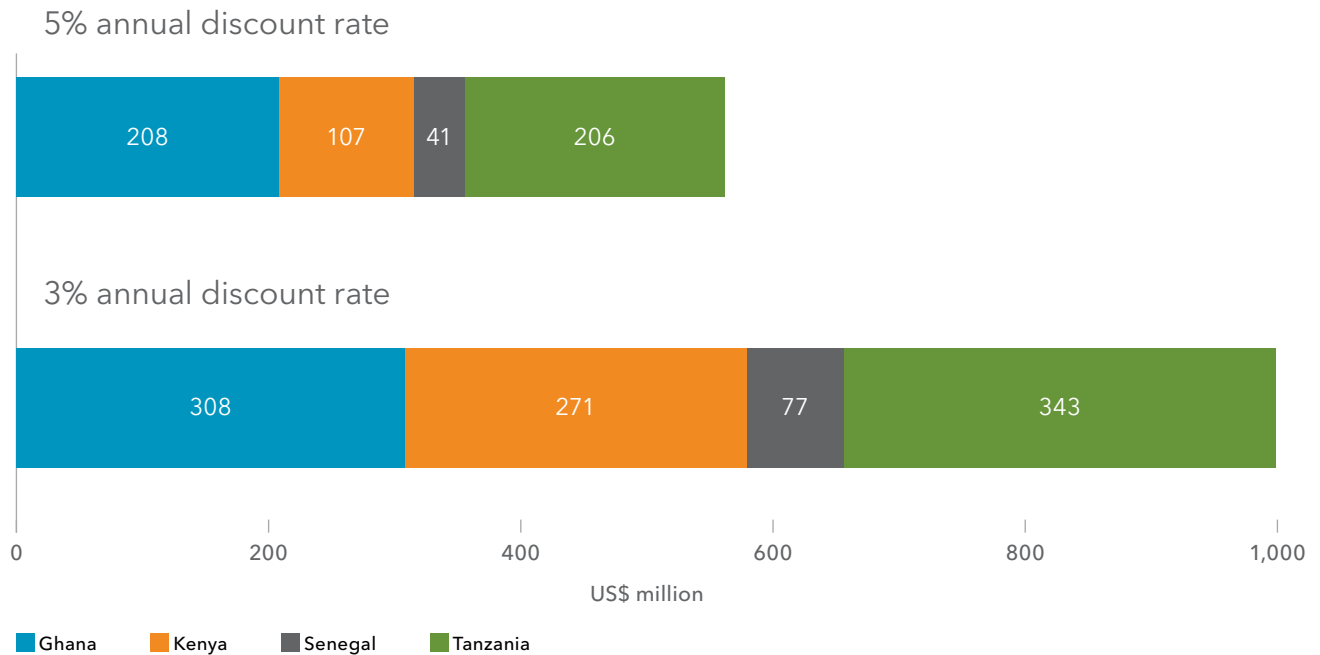
- The cost of building a 0.7 million MT plant in Africa would be roughly US\$700 million, using as a reference the estimated cost of the nitrogen plants recently constructed in Nigeria’s Delta and Lagos States (US\$2.5 billion for two 1.3 million MT plants).
- The investment costs of the plant, which could be built in any of the countries in the region, are prorated based on the relative amount of fertilizer (nitrogen) consumed by each country according to the International Fertilizer Industry Association open-access database and FAOSTAT.⁹ For example, because Kenya accounts for 52 percent of the total fertilizer used among the four countries (Ghana, Kenya, Senegal, and Tanzania), Kenya would cover 52 percent of the building costs of the plant.
- The cost per MT of nitrogen production is US\$130 for a plant with a capacity of over 1,000 MT per day or over 330,000 MT per year.¹⁰ The bagging costs are US\$5 per MT and inland transportation costs are US\$40 per MT.¹¹

INCOME ASSUMPTIONS:

- Only 20 percent of the rural population in each corresponding country will show an effective 1 percent increase in income. Some farmers may already be using the optimal amount of fertilizer, while for others the increase in fertilizer use may not be enough to raise incomes.
- The estimated per capita rural income in each country is based on the most recent household survey available at the time of the study: the 2001 Household Survey-ESAM II in Senegal, the 2005/2006 Living Standards Survey in Ghana, the 2005/2006 Integrated Household Budget Survey in Kenya, and the 2007 Household Budget Survey in Tanzania.

The total net present value of such a policy to increase competition in fertilizer markets, over a time horizon of 40 years, would be roughly US\$1 billion in the four African countries using an annual discount rate of 3 percent, or about US\$561 million using an annual discount rate of 5 percent (Figure 6).

Figure 6 Net present value of simulated policy for four African countries



Source: M. A. Hernandez and M. Torero, "Market Concentration and Pricing Behavior in the Fertilizer Industry: A Global Approach," *Agricultural Economics* 44, no. 6 (2013): 723-734.

Note: Estimates assume a time horizon of 40 years.

LOOKING FORWARD

Our analysis provides suggestive evidence of market power exertion along the fertilizer supply chain and shows several potential benefits of increased competition for prices and fertilizer uptake, and ultimately for rural income. As more data become available, future work should continue to examine the workings of the industry to gain a better understanding of competitive behavior along global, regional, and local supply and distribution channels. This information is critical for the design of policies and mechanisms, both globally and locally, that can help prevent market power exertion in the industry.

Any policy designed to promote competition should be complemented by institutional reforms as well as broader investments in infrastructure, provision of basic public goods, development of market information systems, agronomic research, and knowledge generation and dissemination that is based on a full understanding of the market's functioning. Overall, policies to promote sustainable markets for inputs such as fertilizers in Africa south of the Sahara are unlikely to be effective unless new measures are implemented to address the range of structural problems that limit the incentives to supply and use improved inputs.

NOTES

- ¹ M. L. Morris, et al., *Fertilizer Use in African Agriculture: Lessons Learned and Good Practice Guidelines*, Directions in Development Series, Agriculture and Rural Development (Washington, DC: International Food Policy Research Institute, 2007).
- ² FAO (Food and Agriculture Organization of the United Nations), FAOSTAT, www.fao.org/faostat/en/#home; World Resources Institute, EarthTrends database, www.earthtrends.wri.org.
- ³ Green Markets, fertilizer market data, www.fertilizerpricing.com.
- ⁴ V. Kelly, A. Adesina, and A. Gordon, "Expanding Access to Agricultural Inputs in Africa: A Review of Recent Market Development Experience," *Food Policy* 28, no. 4 (2003): 379-404; D. I. Gregory and B. L. Bumb, "Factors Affecting Supply of Fertilizer in Sub-Saharan Africa," Agriculture and Rural Development Discussion Paper 24 (Washington, DC: World Bank, 2006).
- ⁵ IFDC (International Fertilizer Development Center), *Worldwide Capacity Listings by Plant, Several Fertilizer Products* (Muscle Shoals, AL: 2009).
- ⁶ M. A. Hernandez and M. Torero, "Market Concentration and Pricing Behavior in the Fertilizer Industry: A Global Approach," *Agricultural Economics* 44, no. 6 (2013): 723-734.
- ⁷ P. Gruhn, F. Goletti, and R. N. Roy, *Proceedings of the IFPRI/FAO Workshop on Plant Nutrient Management, Food Security and Sustainable Agriculture: The Future through 2020* (Viterbo, Italy, May 16-17, 1995); B. L. Bumb, M. E. Johnson, and P. A. Fuentes, "Policy Options for Improving Regional Fertilizer Markets in West Africa," IFPRI Discussion Paper 1084 (Washington, DC: International Food Policy Research Institute, 2011).
- ⁸ IFDC (International Fertilizer Development Center), *Worldwide Capacity Listings by Plant, Several Fertilizer Products* (Muscle Shoals, AL: 2009).
- ⁹ International Fertilizer Industry Association, online dataset, www.fertilizer.org; FAO, FAOSTAT, www.fao.org/faostat/en/#home.
- ¹⁰ Fertilizer Institute, *Production Cost Survey*, www.tfi.org/our-industry/market-intelligence.
- ¹¹ Chemonics International Inc. and International Center for Soil Fertility and Agricultural Development, *Fertilizer Supply and Costs in Africa* (Seattle, WA: Bill & Melinda Gates Foundation, 2007).

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