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OVERVIEW OF THE FERTILIZER SUPPLY CHAIN AND MARKET STRUCTURE IN AFRICA:

A Cross-country Assessment

Manuel A. Hernandez, Florencia Paz, Adetola I. Adeoti, Annet Adong, Charles B.L. Jumbe, Kiplimo Araap Lagat, and Stevier Kaiyatsa

KEY FINDINGS

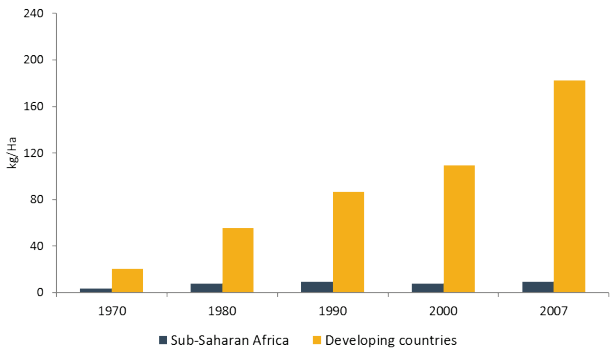
- Fertilizer use in Africa south of the Sahara remains low and is characterized by slow growth.
- There is a positive correlation between fertilizer market concentration and fertilizer prices.
- Poor infrastructure, high transport costs, and low access to credit pose some of the biggest barriers to the development of the fertilizer market in the region.

Agriculture continues to play an important role in African economies. According to the African Development Bank, agricultural activities comprise around 15 percent of the continent's gross domestic product (GDP) and agricultural employment represents around 58 percent of total employment in Sub-Saharan Africa. The region's population is expected to double to 2 billion people by 2050. Along with expected income growth, the population increase will lead to a substantial rise in food requirements. To meet food demand, FAO estimates that agricultural production would have to increase 112 percent between 2013 and 2050.

Meeting this demand will not be easy, as agricultural productivity in SSA remains low and shows slow growth. The vast majority of African smallholder farmers produce low-yield food crops using a minimal set of inputs. Inadequate access to improved inputs such as fertilizers presents a major constraint for smallholders. In the region, more nutrients are removed with harvested crops than are applied with fertilizer or manure, resulting in unsustainable soil nutrient depletion. Improved fertilizer use will help to counteract this trend while substantially improving food security.

The Abuja Declaration of 2006 called for improvements in access to, affordability of, and incentives for fertilizer use. Yet, fertilizer uptake in the region has hardly improved and lags well behind the rest of the world. Figure 1 shows how the gap in the intensity of fertilizer use between SSA and other developing countries has continuously increased over time. As of 2007, fertilizer intensity averaged 10 kilograms (kg) per hectare (ha) in SSA compared with 187 kg/ha in the rest of developing countries.

Figure 1: Fertilizer intensity use in SSA and the rest of developing countries



Source: World Resources Institute (WRI).

Many studies have assessed the supply- and demand-side constraints that limit fertilizer uptake. Relatively little is known, however, about the market structure and competitive behavior along the fertilizer supply chain. The fertilizer industry is highly concentrated at the global level, which could be leading to non-competitive pricing. Countries in SSA import most of the inorganic fertilizer used in agriculture. Local fertilizer distribution channels are also characterized by high concentration, with few traders dominating most of the market in a context of a generally poorly functioning dealer network.

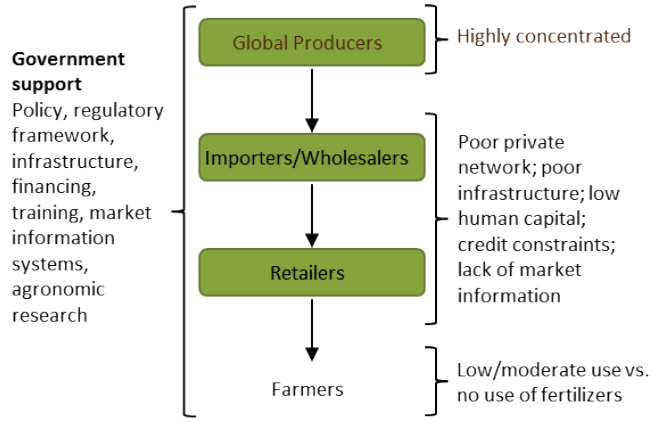
Fertilizer prices have increased substantially in the region in recent years, in part due to higher shipping costs and inland trucking and rail costs. These price increases come on top of already high cost. Fertilizer sold in SSA is the most expensive in the world. This higher cost for African farmers is associated with a number of obstacles in the functioning of fertilizer markets, including – as discussed further below – potential non-competitive pricing behavior along the supply chain. Deeper analysis of how

fertilizer supply and distribution channels operate at the global, regional, and local levels is critical to the understanding of the low fertilizer uptake in the region. This note provides a global and local overview of the fertilizer supply chain and market structure in selected African countries, identifies key constraints, and provides some concluding remarks and ways to move forward.

THE FERTILIZER SUPPLY CHAIN: A GLOBAL PERSPECTIVE

Figure 2 presents a schematic illustration of a typical fertilizer supply chain in SSA countries, as well as the support received by the government and the major bottlenecks faced along the supply channel. Compared to other developing regions, SSA relies heavily on imported fertilizers.

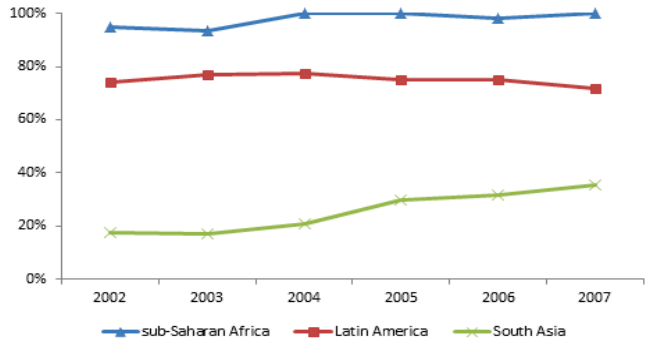
Figure 2: Typical Fertilizer Industry in SSA



Source: Authors' elaboration.

As shown in Figure 3, during 2002-2007, almost all of the fertilizer used in SSA was imported. In Latin America and South Asia, on the other hand, the proportion of imported fertilizer represented 75 percent and 20-30 percent, respectively, of total consumption. Thus, import (international) prices make up an important fraction of the final price that farmers pay for fertilizers in SSA.

Figure 3: Imports of fertilizer as a percentage of consumption, 2002-2007

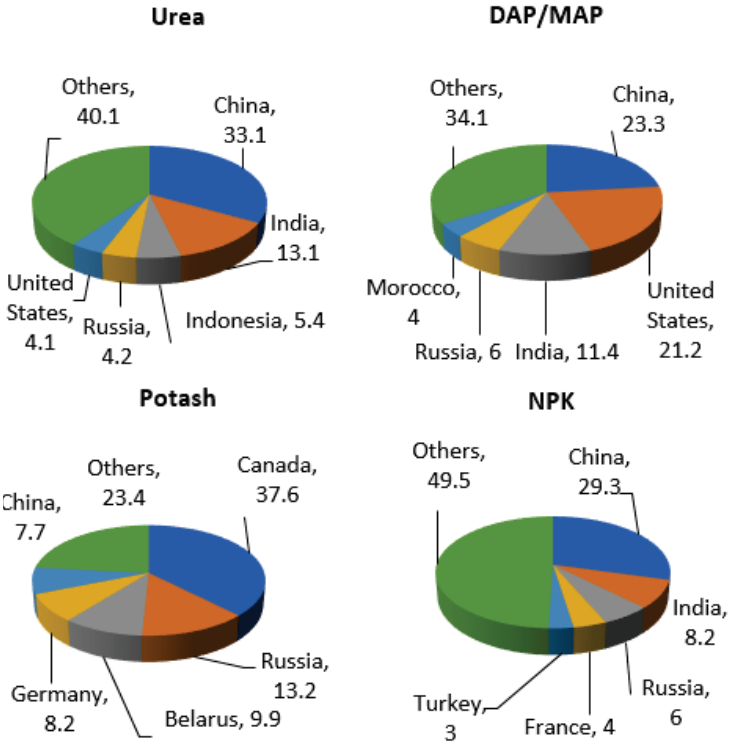


Source: FAOSTAT Online database. Elaborated by: Hernandez and Torero (2011).

At the global level, the fertilizer industry is characterized by high and increasing levels of concentration. Five countries control 50-80 percent of the world's production capacity for the major nitrogen, phosphate, and potash fertilizers, as shown in Figure 4. In addition, among these major producing countries, the top four firms control roughly more than 50 percent of each country's production capacity (except in China).

These high levels of concentration result largely from the fact that fertilizer production relies on raw materials that are not available worldwide. In addition, fertilizer production requires large upfront investment with sizable economies of scale. Yet high concentration levels can also generate market power exertion and tacit collusion among the few operating firms. These market power effects could be outweighing cost-efficiency effects in the industry. For example, during the food price crisis of 2007-2008, fertilizer prices exhibited higher spikes than oil and agricultural prices.

Figure 4: Distribution of world fertilizer production capacity by country.



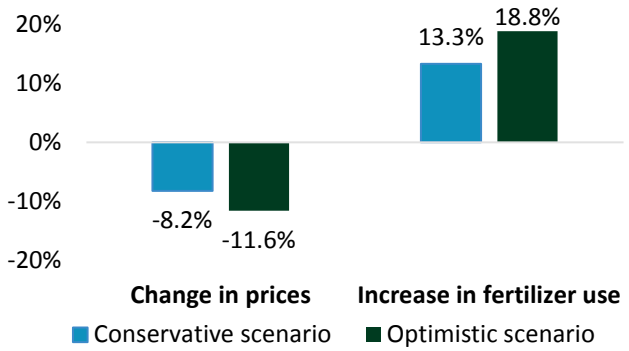
Source: International Fertilizer Development Center (IFDC) (2009).

Market concentration and prices at the global level

The positive correlation between market concentration and prices has been quantified by Hernandez and Torero (2013), who show that a 10-percent decrease in concentration at the global level will have positive effects on fertilizer use, crop production, and, consequently, rural incomes. Figure 5 shows that this decrease in global market concentration could result in a decrease in fertilizer prices of 8-12 percent and an increase in fertilizer use of almost 13-19 percent, based on a conservative and an optimistic scenario.

Hernandez and Torero (2013) analyze the relationship between urea prices and market concentration using a dynamic panel model with annual data for 38 countries and considering two measures of market structure based on production capacity and number of plants.

Figure 5: Percent change in prices and fertilizer use based on a 10-percent decrease in concentration.



Note: Assuming elasticity of fertilizer use to prices of -1.6. The conservative scenario considers the lowest estimated partial correlation between market concentration and prices obtained from using different measures of market concentration (e.g., Herfindahl-Hirschman Index and top-4 concentration ratio) based on production capacity and number of plants, while the optimistic scenario considers the highest estimated partial correlation. Source: Hernandez and Torero (2013)

THE FERTILIZER SUPPLY CHAIN: A LOCAL PERSPECTIVE

Several comprehensive studies on selected countries were implemented to gain a better understanding of the fertilizer supply chain in SSA: Kenya, Malawi, Nigeria, and Uganda. These countries were chosen because they exhibit relatively different levels of market development and consumption patterns. The main objective was to obtain a detailed overview of the supply chain in these countries, including an in-depth description of market actors, structure, practices, outcomes, and constraints faced.

The primary data sources for these studies consisted of surveys of fertilizer traders in main market centers in each country. Importers, wholesalers, and retailers were randomly selected from a list of active traders operating in each market center. The surveys collected information on prices, volume of fertilizer traded, and company characteristics. Table 1 presents the total number of traders of each type interviewed by country.

Table 1: Traders interviewed in each country

Dealer Type	Kenya		Malawi		Nigeria		Uganda	
	Obs.	%	Obs.	%	Obs.	%	Obs.	%
Retailer	340	67	30	83	450	67	77	44
Wholesaler	126	25	3	8	220	33	45	26
Wholesaler/ Distributor	34	7	0	0	0	0	0	0
Distributor	6	1	0	0	0	0	0	0
Importer	1	0	3	8	2	0	52	30
Producer	0	0	0	0	2	0	0	0
Total	507	100	36	100	674	100	174	100

Source: Authors' elaboration.

The information collected through the surveys was complemented with secondary data, including census, administrative, and household data.

Market structure and characteristics

Table 2 summarizes some general market characteristics of the selected countries. Nigeria exhibits higher aggregate fertilizer consumption than the other countries; however, when adjusting by the amount of arable land in the country, it has much less intense fertilizer use: 10 kg/ha, which is similar to Uganda and to the region's average. Farmers in Kenya and Malawi, on the other hand, use 35 and 43 kg/ha, respectively.

Nigeria engages in nutrient production, while Kenya utilizes domestic blending plants (hoppers) and Malawi both blending plants and a small granulation plant. Uganda does not produce or blend any fertilizer domestically. Nigeria's total daily production capacity for nitrogen is 466 metric tons (MT); the production capacity of Kenya's blending plants is about 110 MT (due to the recent opening of a second plant), while Malawi's blending plants can produce 321 MT per day. Despite this domestic production, however, these countries remain highly dependent on imported fertilizer.

Government involvement in the fertilizer market also varies. In Malawi and Uganda, fertilizer markets are deregulated and liberalized. In Kenya, the market is also deregulated; while the government participates in some international fertilizer purchases, the private sector controls most fertilizer imports. In Nigeria, on the other hand, the government was heavily involved in the fertilizer distribution channel until the e-Wallet fertilizer subsidy program began in 2012, which shifted distribution to the private sector. In addition, all of the studied countries have active fertilizer subsidy programs except for Uganda.

Table 2: Market characteristics by country

Description	Kenya	Malawi	Nigeria	Uganda
Total consumption (MT)	597,024	259,120	959,735	53, 180
Intensity of use (kg/ha)	35	43	10	10
Production/Blending	Blending	Blending	Production	None
Active subsidies	Yes	Yes	Yes	No

Note: Data for Kenya and Nigeria come from AfricaFertilizer.org for 2016. Data for Uganda come from AfricaFertilizer.org for 2013. Data for Malawi come from IFDC/New Partnership for Africa's Development (NEPAD) from 2007. Source: Authors' elaboration.

Kenya

The process of market liberalization in Kenya began in 2000 and resulted in a continuously growing network of agro-dealers. In 2015, for example, there were nine times more fertilizer retailers and 2.5 more wholesalers than in 2005. In 2007-2008, the government implemented a series of smart subsidies to allow for more fertilizer imports. Currently, imports account for 86 percent of the fertilizer supply in Kenya.

Thus, Kenya's domestic fertilizer supply remains very limited. Prior to 2017, the country had only one blending plant, with an annual production capacity of 40,000 MT. A second blending plant was recently opened with a capacity of 100,000 MT.

Kenya has three market distribution channels: an extensive distribution network of agro-dealers, a vertically integrated chain for specific high-value (export) crops, and the government's National Cereals and Produce Board (NCPB). The most commonly

used channel is the private distribution network composed of importers, wholesalers, and retailers. This network provides inputs to all farmers at regular prices and at subsidized prices through vouchers. Farmers who export high-value crops such as tea, coffee, and sugar generally access inputs through a separate integrated distribution system. Lastly, the NCPB, which controls about one-quarter of the market share, imports and distributes fertilizer at subsidized prices through its network of stores or depots across the country.

Kenya's network of agro-dealers covers vast geographic distances. The average distance to the point of purchase traveled by wholesalers and retailers is 127 km, while distributors travel about 500 km to the port of entry in Mombasa. However, both the quantity of fertilizer purchased and the storage capacity decrease downstream along the supply chain. Transport costs account for an average of 10 percent of the final price paid by farmers.

The average volume of sales during the planting season for Kenyan wholesalers and retailers is 1 MT and 0.5 MT, respectively. Wholesalers who also operate as distributors have a higher average sales volume of 4 MT.

Access to credit remains limited. Only 33 percent of traders borrow from financial institutions to purchase fertilizer. In terms of sales, retailers tend to sell more on credit than wholesalers and distributors.

Retailers also enjoy slightly larger price margins (i.e., the difference between sale and purchase price). Price margins for retailers range from 350-410 Kenyan shillings (US$ 3.50-4.10) per 50kg bag, while price margins for wholesalers range from 280-370 Kenyan shillings (US$ 2.80-3.70).

Malawi

Malawi's first efforts to deregulate the fertilizer market began during the 1980s, but it was not until the food crisis of 1997-1998 that the government started to massively distribute free inputs to smallholder farmers through the "Universal Starter Pack".

In 2005, the national Farm Input Subsidy Program (FISP) was implemented, focusing on both fertilizer and seeds. Through FISP, a farmer is entitled to three vouchers: one for two 50kg bags of fertilizer, one for 5kg of hybrid maize seed, and one for 2kg of legume seed. As a result of the program, fertilizer use and maize yields doubled, prompting the further expansion of the program. In 2009, FISP represented 13.5 percent of the national budget. Since 2014, however, budget constraints have reduced the funds available for fertilizer subsidies; as a result, maize yields have fallen by nearly 40 percent.

Almost all of Malawi's traded fertilizer (93 percent) is imported, and the remaining fertilizer comes from national producers consisting of two large, privately owned blending plants and one small granulation plant. These domestic producers have a total daily production capacity of 321 MT.

Malawi's fertilizer supply channel is composed of major distributors who import fertilizer and supply it to their networks. Independent agro-dealers source their fertilizer from these distributors and sell it in smaller quantities to small-scale farmers, particularly in rural areas. The government purchases fertilizer from both domestic fertilizer producers and importers; this fertilizer is then distributed to farmers through the national subsidy program. Some of this subsidized fertilizers also get diverted to the open commercial market through independent agro-dealers; however, the fertilizer sold by these independent agro-dealers is more expensive than the subsidized fertilizer.

On average, wholesalers sold 14,000 MT of fertilizer during the 2015-2016 season. At the retail level, distributors sold 1,363 MT of fertilizer, whereas independent agro-dealers sold 6.15 MT of fertilizer in a few selected markets. Therefore, distributors sell significantly higher quantities of fertilizer than independent agro-dealers.

Fifty-three percent of the sampled independent agro-dealers utilized formal credit to support their businesses at the time of the survey. Fertilizer prices tend to be lower in the Southern than in the Northern regions, as the main port of entry is in the South. Transport costs account for 18 percent of the final price paid by farmers.

The price margin between wholesalers and importers averaged 12,677 Malawian kwacha (US$ 17.85) per MT of fertilizer sold during the 2015-2016 season. Distributors have a price margin of 634.90 Malawian kwacha (US$0.89) per MT of fertilizer sold, whereas independent agro-dealers have a markup of 4,615 Malawian kwacha (US$6.47).

Nigeria

Nigeria's government has been involved in the fertilizer market since the 1970s. Early government interventions resulted in subsidization of up to 95 percent of the total cost of fertilizer. In 1997, however, high costs and inefficiencies prompted the sudden liberalization of the fertilizer sector. However, the (still) underdeveloped private sector could not cope with the demand. As a result, fertilizer use fell rapidly.

The government implemented several subsidies to improve the situation, resulting in a wide array of (subsidized) prices across states. Due to market inefficiencies, suppliers have mainly focused on purchases from the government. As a result, Nigeria's fertilizer market is divided into two parallel supply chains: the private sector and the federal government. The private fertilizer retail network is small and remains concentrated in state capitals. The country also has 10-12 small importers, including fertilizer blending plants. The federal government distributes fertilizer through its subsidy program.

A network of private fertilizer manufacturers and blenders of nitrogen and phosphates provides Nigeria's domestic fertilizer supply. Most of Nigeria's domestic production (91 percent) is nitrogen-based. Production peaked between 1988 and 1993; since then fertilizer imports have increased four-fold.

Most retailers and wholesalers are privately owned; only around 2 percent are cooperatives and government agencies. The volume of annual sales reported by wholesalers is about 417,000 kg for complex fertilizer (NPK); this number is about 2,342 kg for retailers.

Nigeria's fertilizer prices are among the most expensive in the region and have increased over time. In 2010, the average urea price in Nigeria was US$656 per MT, compared to US$400 per MT in 2003 (US$270 per MT in the US). There are also regional disparities, with lower prices in the South-West states than in the Northern states. Transport costs per 50kg bag average around 162 Nigerian naira (US$0.53), which is roughly 2.4 percent of the final price paid by farmers.

Access to credit for fertilizers in Nigeria is rare. Between 65 and 75 percent of surveyed retailers reported a lack of access to credit. Overall, only 28 percent of retailers had access to some kind of credit at the time of survey.

Wholesalers' average price margin per 50kg bag of fertilizer is 757.93 Nigerian naira (US$2.48), while the average price for retailers is 626.95 Nigerian naira (US$2.05).

Uganda

In Uganda, the fertilizer market is fully liberalized and has minimal involvement from the government. Currently no fertilizer subsidy programs exist, although there are plans underway to implement an e-voucher subsidy program covering 10,000 farming households. However, all agricultural inputs are exempt from input taxes.

As a result, the private sector is the main driver of the fertilizer market in Uganda. All wholesalers are privately owned. However, the market is structured as an oligopoly in which ten wholesalers control 70 percent of the market. Similarly, 50 percent of wholesalers participate in retail sales, and most wholesalers are vertically integrated with importers.

Differences in sale prices across locations are mainly due to differences in transportation costs. Transport costs account on average for 20.2 percent of the final price paid by farmers. Most wholesalers are concentrated in the Central region, and the Northern region has the least number of wholesalers.

Average volume of sales for wholesalers in 2016 was 3,730 kg (about 75 50kg bags), while for retailors, average sales volume was 748.2kg (15 50kg bags).

While Uganda relies entirely on imported fertilizer, the country has the potential to produce both phosphate- and nitrogen-based fertilizers. Despite this capacity, however, fertilizer imports have continued to show an upward trend in recent years.

Traders in general have some access to formal credit. For example, 50 percent of importers reported obtaining loans from banks in past years. Similarly, nearly half of the wholesalers sampled obtained loans in the previous year, the great majority of which came from commercial banks. Forty-two percent of retailers reported obtaining a loan, mainly from commercial banks and microfinance institutions.

Wholesalers generally have two price margins depending on the amount of fertilizer sold. If a buyer purchases more than three 50kg bags, the average price margin is about 387 Ugandan shillings (US$0.11) per kg of fertilizer; if the buyer purchases less than three 50kg bags, the price margin is 735.4 Ugandan shillings (US$0.21) per kg. Retailers have an average price margin of 703.7 Ugandan shillings (US$0.20) per kg.

Key constraints at the local level

In all of the sampled countries, the largest constraints to the development of the fertilizer market appear to be limited capacity and inefficiencies in the main port of entry. For example, in Nigeria, inefficiencies include late delivery and poor product quality, diversion of the product, theft from government depots, and smuggling to neighboring countries. In Uganda, delayed deliveries from suppliers in Kenya sometimes force importers and wholesalers to rely on internal purchase from other wholesalers to meet their customers' needs.

As previously stated, all four countries depend heavily on imported fertilizer from a highly concentrated global industry. An unfavorable foreign exchange coupled with high price volatility also constitutes a major challenge for imports. Fertilizer prices in remote areas are also highly influenced by transportation costs, which are in part connected with poor transportation infrastructure.

In Kenya, several traders identified limited access to affordable credit as a major constraint. Traders also pointed out that the government's recommendation for fertilizer use does not take into account varying soil characteristics or the different types of fertilizer needed for different crops. They reported that this oversight ultimately limits sales.

The large size of standard fertilizer packaging and the natural bulkiness of the product also limits its storability; combined with high storage costs, this represents another bottleneck for the development of the fertilizer industry. This was particularly highlighted by traders in Kenya and Uganda.

Lack of knowledge regarding how to use and apply fertilizers poses a hurdle in most countries. This issue was particularly emphasized in Nigeria and Uganda. Further, in Kenya some farmers have the misperception that fertilizers can negatively affect their land soil. Several retailers in Uganda also mentioned the problem of counterfeiting, which results in distrust from farmers and, consequently, decreased demand for fertilizer.

Figure 6: Summary of key local constraints

Constraint	Kenya	Malawi	Nigeria	Uganda
Poor or lack of Infrastructure (High transport costs)	✓	✓	✓	✓
Limit access to credit	✓			
Lack of knowledge on how to use fertilizer			✓	✓
Price volatility	✓	✓	✓	✓
High cost of storage space	✓			✓

CONCLUDING REMARKS AND WAYS FORWARD

Fertilizer use is unlikely to experience sustainable growth in SSA unless new measures are implemented to address structural problems that limit incentives to both supply and use fertilizer.

The positive correlation between market concentration and prices at the global level suggests the need to further evaluate the extent of market power exertion in SSA's fertilizer industry. This is particularly true considering the region's high dependence on imported fertilizer. More in-depth studies are also needed to further understand the workings of the supply chain at the regional and local levels.

Some specific actions that could be taken to promote competition in the region's fertilizer industry include the establishment of antitrust laws to encourage competitive trade flows across countries and the development of a regional platform to evaluate investment opportunities. More regional production to increase supply and eventually decrease prices could be achieved through

greater investments from major producers and governments or through public-private alliances.

At the regional and local levels, transportation costs also need to be reduced. In Nigeria, for example, reducing transportation costs by 50 percent would increase the number of plots with profitable fertilizer use by 40 percent; if costs fell by 75 percent, the number of plots could increase by up to 60 percent (Liverpool-Tasie et al., 2015). In order to lower transportation and storage costs, better infrastructure is essential, particularly in poorer and more isolated locations.

Other structural problems that reduce incentives to supply and use fertilizer also require further examination. These include policy and institutional reforms, knowledge generation and dissemination, and market information systems.

Finally, to drive sustainable market development in the region, demand needs also need to be further examined. For instance, it is important to distinguish between farmers who are already using low or moderate quantities of fertilizer and those who are not using fertilizer at all. The research question will change depending on the population in question. For example, if the target is the former group, how much extra fertilizer do they need? If the target is the latter group, why they are not using fertilizer?

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Manuel A. Hernandez is a Senior Research Fellow and **Florencia Paz** is a Research Analyst at the International Food Policy Research Institute (United States). **Adetola I. Adeoti** is a Professor in the Department of Agricultural Economics at University of Ibadan (Nigeria). **Annet Adong** is currently a PhD student at Center for Development Research, University of Bonn Germany and formally a Research Analyst at the Economic Policy Research Centre of Makerere University (Uganda). **Charles B.L. Jumbe** is a Professor at Lilongwe University of Agriculture and Natural Resources (Malawi). **Kiplimo Araap Lagat** is an Executive Committee Member for Trade, Investment and Industrialization in the County Government of Nandi, (Kenya). **Stevier Kaiyatsa** is an Economist in the Ministry of Finance, Economic Planning and Development (Malawi).

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INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

1201 Eye Street, NW, Washington, DC 20005-3915 USA | T. +1.202.862.5600 | F. +1.202.862.5606 | ifpri@cgiar.org | www.ifpri.org

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