

## **Consumption Patterns and Competition in the World Fertilizer Markets**

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**Abstract:** In this study, we analyse competition in the global nitrogen fertilizer markets. We based our analysis on demand and supply side effects, both in the European fertilizer markets and in the global markets. Our analysis shows that fertilizer industry has responded to changes in demand by shifting production from areas with declining consumption to those with rapidly increasing consumption. At the same time, fertilizer trade-flows have become more concentrated. Changing demand patterns have also made it easier to relatively smaller firms to compete with the giants in the fertilizer market.

**Keywords:** global fertilizer market, market concentration, trade-flows

### **1. Introduction**

#### **1.1. Background**

Fertilizer markets have been in turbulence within the last few years. Global increase in agricultural product prices led to increasing demand of fertilizers. At the same time fertilizer raw materials such as natural gas, phosphate rock and potash faced rapidly increasing world market prices. The longer trend has been the shift in consumption. Fertilizer consumption has remained constant or declined in Western Europe and North America, but increased rapidly especially in China and India. It is anticipated that in the near future 89 % of the increase in world fertilizer consumption will come from East Asia, South Asia, and Latin America together. These changes in demand patterns have major influence on fertilizer trade flows, firms' investment decisions and thus, to regional and global competition.

Overall, the fertilizer market is composed of three primary nutrients, which all have essential and complementary roles in the ecological processes of plants. Nitrogen is the most important nutrient in the world, accounting for 60 % of total nutrient consumption. The other two main nutrients are phosphorus and potassium. While nitrogen fertilizers are manufactured directly via chemical processes, the production of phosphate and potash fertilizers involves digesting and mining activities. Two key raw materials for nitrogen fertilizers are natural gas, which is widely available in many parts of the world, and air. Yet, all nitrogen fertilizers are manufactured from ammonia, processed directly from natural gas. The availability of raw materials makes the manufacture of ammonia and thus nitrogen fertilizer possible in a variety of locations. However, phosphate rock, the raw material for phosphate fertilizers, and potash mineral deposits are only available in certain

regions of the world, especially in Canada, Russia and some European countries. Because of the dominant role of nitrogen in the world fertilizer trade and differences in production processes, we limit our analysis on world nitrogen fertilizer markets.

## **1.2. Objectives**

The purpose of this paper is to analyse the changes in the global nitrogen fertilizer production and consumption patterns. We will analyse both demand and supply side effects, first in the global market and then, in terms of their direct effects on the European fertilizer markets. In addition to trade analysis, we provide some firm-level indicators of the market shares and concentration in the industry and also present the development in the economic performance of the top fertilizer firms in recent years. Our analysis will reveal the main factors affecting behind different consumption patterns and how the changes in these patterns have affected on global fertilizer industry.

We will analyse nitrogen fertilizer markets in terms of trade-flows, shifts in consumption and production as well as firm level competition. Shifts in production are analysed via the changes in ammonia production capacity. We use urea, the most important single nitrogen fertilizer, to describe the most relevant trade-flows in the world markets. On the firm level analysis, we compare the firm level indicators of five biggest fertilizer companies and their eight strongest challengers. Based on those indicators, we will draw some conclusions on competition in the world markets. The question is whether these eight strong challengers are able to compete with the world's leading fertilizer companies in terms of profitability and growth. If the answer is positive, we can conclude that the leading firms are also hard-pressed to become more efficient in this highly competitive industry.

## **1.3. Theoretical background**

According to theory, in a perfectly competitive market, a firm has no market power: the firm's demand curve is perfectly elastic and the price equals the marginal cost. In other words, firm is a price taker: it cannot influence the price that is paid for its product. Therefore, firms in a competitive environment are more hard-pressed to reduce costs and become more efficient. A firm that makes inefficient decisions incurs losses because it cannot transmit its extra costs to the consumers. Government interventions also reduce the efficiency of competitive markets (Tinbergen 1962).

Competitiveness can be measured in terms of market shares, market concentration and firm level growth. Large market shares and a high degree of market concentration will curb competition within a market. The more concentrated a market is, the more likely it is that the market actors can utilize market power. Thus, the market concentration ratio is an important index to consider when analyzing competition and market structure. Perhaps the most common way to measure market concentration is to calculate the market shares of the largest actors (e.g. Tirole 1988).

#### **1.4. Structure of the paper**

In the second section, we describe world fertilizer markets in terms of changes in production, consumption and trade during the period of seven to ten years since late 1990s till 2006. In section three, we focus on competition on the fertilizer markets. We will carry out a firm level analysis to compare the economic performance of different firms and to analyse the development of five strongest compared to eight biggest competitors in terms of market shares and development in profitability. Finally, we will conclude our findings in section four.

### **2. World fertilizer markets**

#### **2.1. Production and consumption**

Generally speaking, population growth and economic growth are the main drivers for increased fertilizer consumption. The Asian share of global fertilizer consumption is about 65 %, and growing rapidly. Developments in Asia will continue to play a major role in how the global fertilizer market will develop. Demand in Latin America has been rapidly increasing due to the strong development in the agricultural sector. Consumption in the mature markets of North America and Europe is stable, and forecast to remain stable.

Due to the historical structure of mainly nationally owned fertilizer industries, nitrogen fertilizers are still manufactured in relatively small plants. With the exception of Norwegian-based Yara International, nitrogen fertilizer manufacturers in the EU-27 operate mainly within the European Union. In addition, rising gas prices in Europe have caused European ammonia producers to close a number of ammonia plants and instead purchase ammonia on the world market. During the last 20 years more than half of the fertilizer plants in the EU-15 area have disappeared (EFMA 2008).

The availability of natural gas is essential for nitrogen fertilizer production. While natural gas is difficult and relatively expensive to transport, the nitrogen fertilizer production capacity in regions

with low-cost gas reserves is being significantly expanded. There are on-going investments in Russia, Egypt and Algeria that will multiply the ammonia production capacity in those regions in the coming few years (EFMA 2008, IFA 2008, Yara 2008).

In Figures 1 and 2 are presented the changes in ammonia production and consumption during the period 1999-2006 according to regions. Even in a short period, one can see quite large changes in production: Asia, Eastern Europe and Latin America have increased their ammonia production sharply, while in Western Europe and North America, production has decreased. The changes in regional consumption are similar to the changes in regional production: Consumption has increased mostly in Asia and Eastern Europe. The consumption of ammonia has decreased in Western Europe and North America. If we combine the information from Figures 1 and 2, we get the changes in net exports during 1999-2006 according to regions. Latin America, Eastern Europe, and Western and Central Asia have increased ammonia export while North America and South Asia have been the largest ammonia importers (Fertecon 2007a).

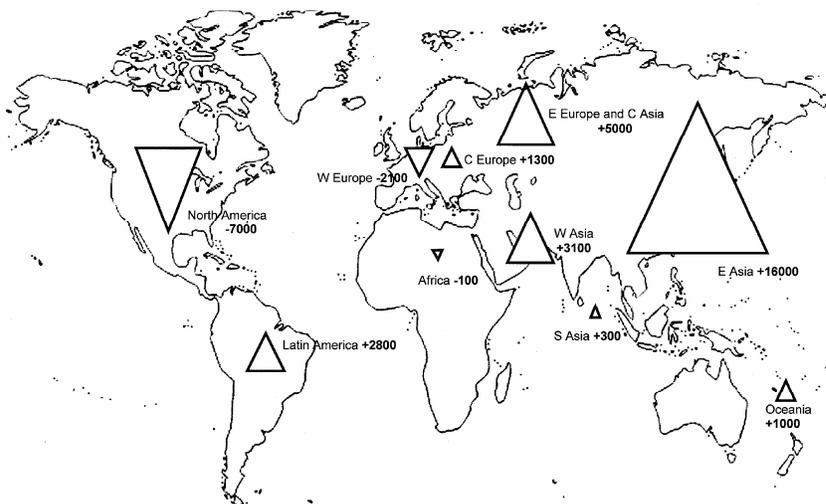


Figure 1. Change in Ammonia production from 1999 to 2006 by regions (1000 tons) (IFA 2008)

Europe's role as a fertilizer production region has been declining over time, while other world regions are growing in importance. Europe has transformed from being a region in which more nitrogen fertilizers were produced than consumed to one that consumes more nitrogen fertilizers than are produced.

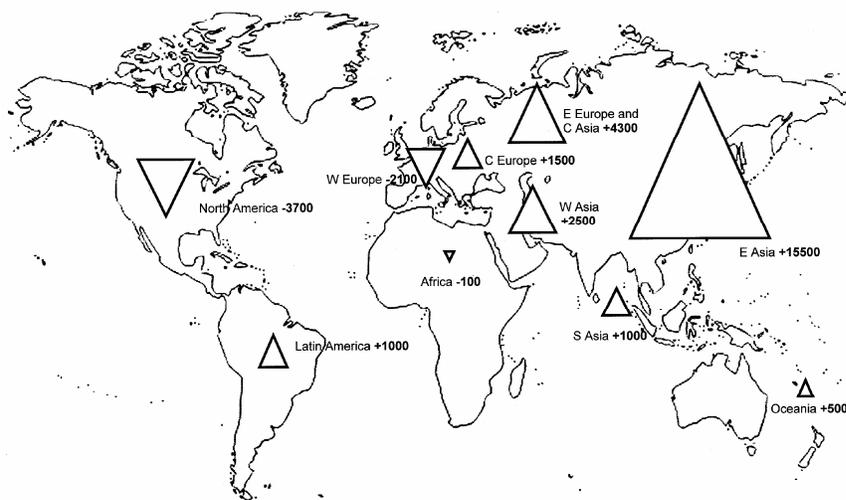


Figure 2. Change in ammonia consumption from 1999 to 2006 according to region (1000 tons) (IFA)

According to FAO (2008) world nitrogen fertilizer demand will increase at an annual rate of about 1.4 % until 2011/2012, which is an overall increase of 7.3 million tonnes. About 69 % of this growth will take place in Asia. In 2007, world ammonia production increased by 3.8 %, reaching 153.6 Mt of ammonia. China contributed half of the net increase.

## 2.2. World trade in the urea market

The most traded product in the global fertilizer markets during the period from 1996-2006 was urea. The biggest exporters included Russia, Ukraine and Qatar. While the EU-15 and CEEC-10 are both big traders, the biggest share of trade was between or within these countries. The biggest importers were Brazil, India and the EU. It is worth noting that China, the world largest urea consumer, does not import amounts that would comprise a significant share in world trade. A major trend in the world markets is that the amount of ammonia and urea traded has increased rapidly. This trend is expected to remain strong in the coming years.

Table 1. Main urea exporters and their partners 1996-2006 (UN Comtrade)

Exporter	Russia	Ukraine	Qatar	CEEC-10	EU-15
Importer	Brazil	India	Australia	EU-15	Canada
	EU-15	Turkey	USA	Turkey	CEEC-10
	Mexico	Pakistan	Thailand	USA	USA
	Peru	Brazil	India	India	Ecuador
	Turkey	Mexico	South Africa	Philippines	Norway

The global average growth in urea consumption has been 3.6 % for the last ten years (2.5% excluding China). Most of the new nitrogen capacity in the world is urea, so it is natural that production/consumption growth rates are high (Fertecon 2007b).

Transportation of urea is relatively inexpensive. It is transported in large ocean vessels between the continents and traded on a worldwide basis. There are two main hubs in urea trade, the Black Sea and Arab Gulf. The trade flows from these areas define the world market prices. Overall, major trade flows are from Black Sea region to Europe, Latin America and India, from the Arab Gulf to North America and Africa, and from North Africa to Europe (Figure 3).

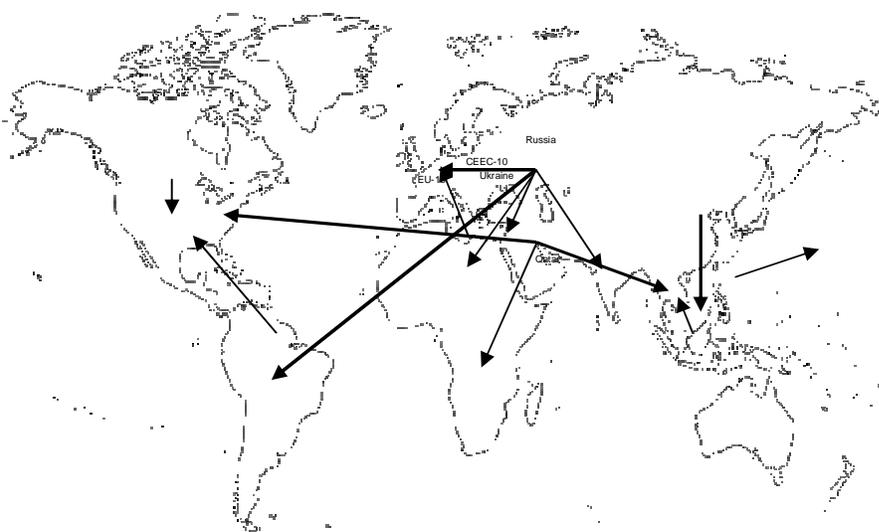


Figure 3. Main urea trade flows and the biggest exporters during 1996-2006 (UN Comtrade)

### 3. Competition in the fertilizer markets

#### 3.1. Market structure

The purpose of this chapter is to analyse whether the fertilizer market is competitive. On a global basis the market is often suggested to be fragmented with relatively small producers. We provide some firm-level indicators of the market shares and concentration in the industry and also present the development in the economic performance of the top fertilizer firms in recent years.

The five largest fertilizer companies in the world are Yara (Norway), The Mosaic Company (USA), Agrium, Inc (Canada), Potash Corporation (Canada) and The Kali & Salz Group (Germany).

## **Fertilizer company presentation**

**Yara** is the largest fertilizer company measured by revenues and the leading fertilizer company in Europe, with approximately 23 % of the European market. In total, Yara has a physical presence in 50 and sales to 120 countries.

Yara is the global leader in nitrogen fertilizers with capacities of ammonia 5.8 million tonnes of ammonia, n 4.8 million tonnes of nitrates (CAN and AN) and 4.1 million tonnes of NPK. Yara has a one-third share of the global ammonia trade.

Yara's target is to achieve a 10 % market share in the global fertilizer market within a business cycle.

Yara owns two large ammonia production facilities in Trinidad and Qafco fertilizer complex in Qatar. Major developments for Yara in the last year included the acquisition of Kemira GrowHow, the signing of a Heads of Agreement for establishing a joint venture in Libya, a decision to upgrade Yara's urea facility in the Netherlands, and contracting for the construction of new ammonia and urea capacity in Qatar.

**The Mosaic Company** was formed in 2004 by the business combination of IMC Global Inc. and the crop nutrition business of Cargill, Incorporated.

Mosaic is the world's top producer of phosphates, with an annual effective capacity of about 9.4 million tonnes, larger than the next three largest producers combined. Mosaic's potash production capabilities are the second-largest in the world, with an annual capacity of approximately 10.4 million tonnes. In addition, Mosaic has an annual nitrogen capacity of 1.2 million tonnes.

Mosaic operates 5 phosphate mines in Florida and 4 potash mines within Saskatchewan, Canada, including the world's largest potash mine, and a potash mine in New Mexico. Approximately one-third of production is shipped within North America, with the remainder exported around the world to some 45 countries.

Mosaic's offshore interests form a production and distribution network in key agricultural markets around the world. Assets within this segment include 20 % stake in Fosfertil S.A. in Brazil, 35 % equity ownership in a DAP granulation plant in China and GSSP plant in Argentina.

Large investments in potash capacity will result in a nearly 30% increase in production capacity in the coming years.

**Agrium, Inc** has annual capacities of 6.5 million tonnes of nitrogen, 2.1 million tonnes of potash and 1.3 million tonnes of phosphate. Agrium operates mainly in North America.

Agrium owns two nitrogen facilities that target international markets, one in Argentina and the other at Kenai, Alaska. Primary markets are South Korea, Mexico and Taiwan. Key potash exports markets include China, Brazil and India.

Presently, Agrium is investing in Egypt as part of international diversification. It has also expanded into China through the purchase of a stake in the Chinese fertilizer company Hanfeng Evergreen.

**Potash Corporation** has a 22 % share of the global potash capacity. In response to global demand, projects announced by PotashCorp will raise the annual operational capacity from 10.8 million tonnes in 2007 to 17.2 by the end of 2015.

PotashCorp have strategic investments in four offshore potash businesses: 28 % of Arab Potash Company Ltd. (APC), Jordan; 10 % of Israel Chemicals Ltd. (ICL), Israel; 32 % of Sociedad Química y Minera de Chile S.A. Chile; and 20 % of Sinofert Holdings Limited (Sinofert), China.

**The Kali & Salz Group** extracts potash and magnesium crude salts at six mines in Germany, with an annual output amounting to about 8 million tonnes of products.

With a potash production share of about 12 %, The K + S is the fourth-largest producer in the world and the leading provider in Europe. In addition, K+S is the global leader in potassium sulphate and magnesium. In the case of N fertilizers, K + S Fertiva is an important supplier in Europe and its position is particularly strong in the area of nitrogen fertilizers containing sulphur.

The firm's focus is on the European market but it exports overseas about 40 % of production mainly to Latin America. The K+S Group has become more international with the acquisition of Chilean salt producer SPL in 2006. It is trying to enhance its market position in the established business sectors especially by intensifying the marketing of speciality products. In addition, K+S is seeking growth through cooperation arrangements.

In firm-level analysis it is difficult to distinguish the producers of nitrogen (N), phosphate (P) and potash (K) fertilizers. However, the leading producer is different in all three nutrient markets. Table 2 presents the market impacts of the five largest fertilizer companies per class of nutrient. Yara is an obvious leader in nitrogen products. Similarly, Mosaic Company is a leader in phosphate and Potash Corporation in potash fertilizers. On the one hand, it might be justifiable to ask whether these firms really are competitors. On the other hand, all these firms are present in more than one nutrient market and form at least a threat to other firms in any particular nutrient market

Table 2. Market impact of fertilizer companies

	Market impact		
	Nitrogen (N)	Phosphate (P)	Potash (K)
<b>Yara</b>	+++	+	o
<b>Mosaic</b>	+	+++	++
<b>Agrium</b>	+++	+	+
<b>Potash</b>	++	++	+++
<b>K + S</b>	+	o	+++

+++ very strong; ++ strong; + low; o none

Figure 4 illustrates the nominal turnover of the five largest fertilizer companies from 2000 to 2007. Yara is clearly the largest fertilizer company measured by turnover. The growth of Yara's turnover in 2007 was partly related to the acquisition of the Finland based Kemira GrowHow. The Mosaic Company was formed in 2004 and turnover statistics before that are annual turnovers of IMC Global Inc. All in all, there are no significant differences between these firms in the development of their turnover statistics. Starting from 2002, turnovers have developed positively in all five firms.

The profitability of companies in the fertilizer industry has been very volatile, indicating that the fertilizer market is highly sensitive. Factors that affect the economic performance of the firms include the rate of construction of new production facilities, the operating rates of existing facilities, market conditions in the grain and raw material markets and government intervention. The profitability – measured by the profits after taxes on annual sales – of the top 5 fertilizer industry companies varied from -5 % to 22 % during the period from 2000-2007 (Figure 5). The average profitability ratio since 2000 has been approximately 5 %, although there have been significant

differences between years. The year 2007 seems to have been the best year in the fertilizer industry in this century measured in terms of the profitability of the five largest fertilizer companies<sup>1</sup>.

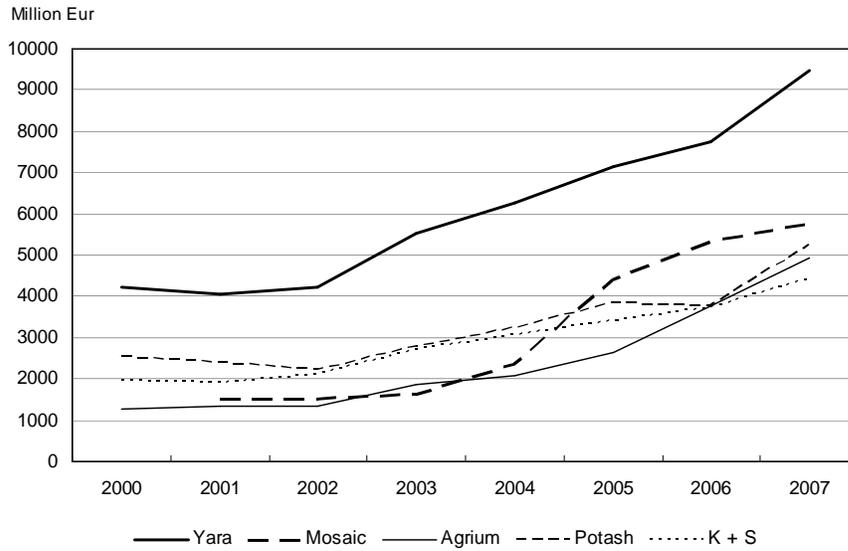


Figure 4. Turnover of the top 5 firms in the fertilizer industry during 2000-2007

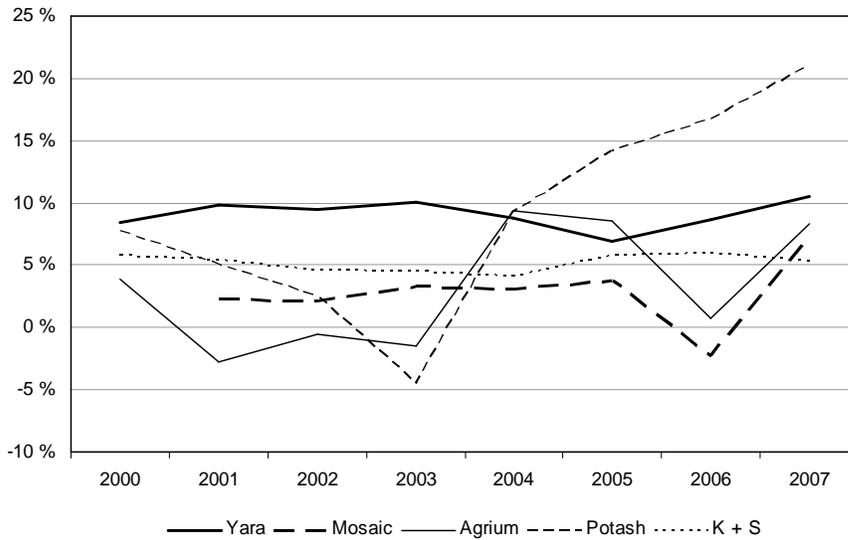


Figure 5. Net profits of the top 5 firms in fertilizer industry during 2000-2007

<sup>1</sup> Year 2008 was most probably even better.

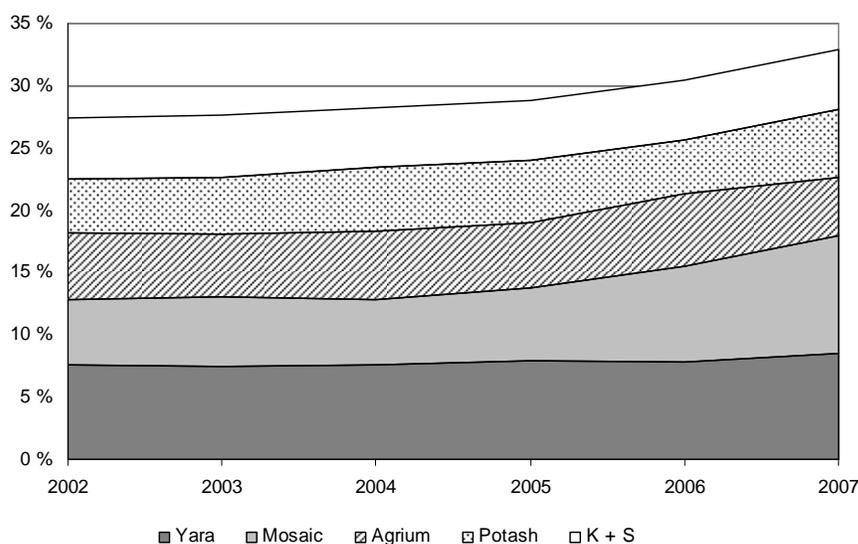


Figure 6. The share of total production of the top 5 firms in the global fertilizer market

During recent years the market shares of the main global fertilizer industry companies have remained relatively unchanged (Figure 6). Only Mosaic Corporation has succeeded in considerably increasing its market share. The production share of the top 5 fertilizer firms was 27 % in 2002 and 33 % in 2007. Altogether, market shares of the largest fertilizer companies are quite small. The 5-firm HHI-concentration ratio in 2007 was less than 250 indicating un-concentrated markets<sup>2</sup>: no fertilizer company has market power. These numbers indicate strong competition in the global fertilizer markets.

In summary, the largest fertilizer companies also face fluctuations in the fertilizer market. The supply-demand balance in the industry, and therefore also the fertilizer prices, cannot be influenced by any single producer. The fertilizer industry operates in a global market, where only companies that manage to increase productivity can prosper in the face of global competition.

Let us consider more closely the situation in the European fertilizer industry. In the past, the fertilizer industry has been affected by weak fertilizer companies that existed as part of government-owned enterprises or conglomerates. The fertilizer industry was seen from a food security point of view rather than from a business point of view. As state involvement is declining, there is a trend towards market orientation and more financial discipline across the industry.

<sup>2</sup> The Herfindahl-Hirschman Index (HHI) is a measure of market concentration. The HHI of a market is calculated by summing the squares of the percentage market shares held by the respective firms. When HHI is below 1000 the market is "unconcentrated", between 1000 and 1800 it is "moderately concentrated", and above 1800 it is "highly concentrated." In this case, the market share is measured in terms of production (tons).

Nowadays, it is important to achieve cost savings and efficiencies that enable companies to continue to compete strongly in the worldwide fertilizers market, particularly in the face of intense competition from N fertilizer producers established in countries with low gas feedstock costs for their ammonia production. Imports of competitively priced N fertilizers from Russia, Ukraine, North Africa and the Middle East will continue to act as a strong competitive constraint on the world biggest fertilizer companies and especially on those located in Europe.

Figure 7 presents some large European fertilizer companies and some fertilizer companies from neighbouring areas. Every company has been marked by a box placed in firm's home country. The height of the box illustrates firm's average profitability (net income/turnover) during the four/five last years (2003/2004-2006/2007). Respectively, the width of the box illustrates firm's average growth of turnover during the same period.

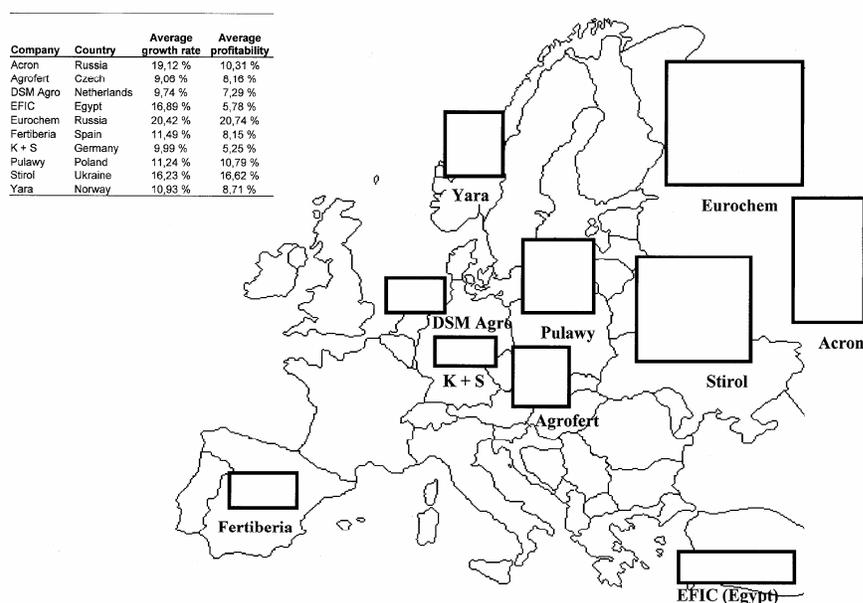


Figure 7. Large fertilizer companies in Europe and neighbouring countries during the four/five last years (2003/2004-2006/2007): Average profitability (height) and growth (width)

Indeed, large European companies have not been as profitable as their Russian and Ukrainian competitors in recent years. Also, the average turnover growth rates of top 5 firms have been lower than their competitors' growth rates in the neighbouring areas. These points have been illustrated in the figure above.

### 3.2. Firm level competition

In this section, we take another view of the global competition in the fertilizer industry. We compare profitability and growth between the top 5 firms and 8 other large fertilizer firms. The question is whether these 8 firms are able to challenge the world's leading fertilizer companies in terms of profitability and growth. If the answer is positive, we can conclude that the leading firms are also hard-pressed to become more efficient in this highly competitive industry.

There are some important points to be noted. Countries follow different accounting practices and compatibility of the financial statement information is therefore problematic. For this reason we collect only a small number of variables (turnover, operating profit, net profit, balance), we use long-term mean values (2004-2007) and we present only ratios. The following table presents the firms in our analysis.

Table 3. Established firm groups.

<b>TOP 5 FIRMS</b>	<b>COUNTRY</b>
Yara	Norway
Mosaic	USA
Agrium	Canada
Potash	Canada
K + S	Germany
<b>8 CHALLENGERS</b>	
Eurochem	Russia
Acron	Russia
Stirol	Ukraine
Sinochem	China
IFCCO	India
SABIC	Saudi Arabia
Fosfertil	Brasil
EFIC	Egypt

Figure 8 illustrates the market shares of the top 5 firms and the 8 strong challengers in 2006 measured in terms of production. In total, the market share of these two firm groups exceeds 52 %. We have managed to capture a considerable proportion of the fertilizer industry measured by production.

Production Shares 2006

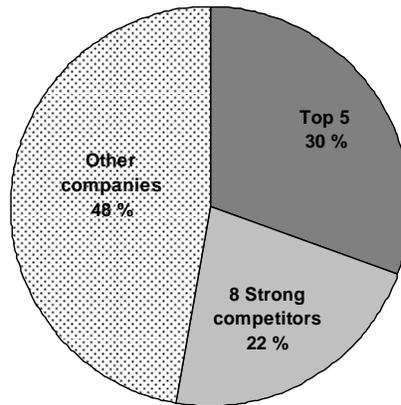


Figure 8. Market shares of the top 5 firms and the 8 strong challengers in 2006.

Figures 9-11 below present each firm's average operating income/turnover ratio, average net income/total assets ratio and average turnover growth rate in the period from 2004-2007.

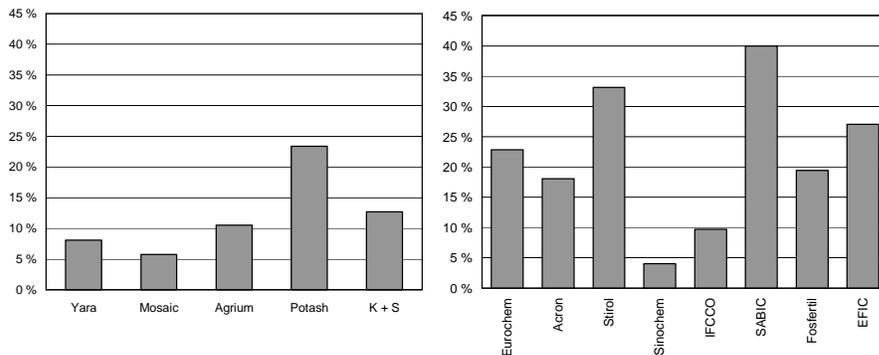


Figure 9. Operating Income / Turnover (%): Annual average during 2004-2007.

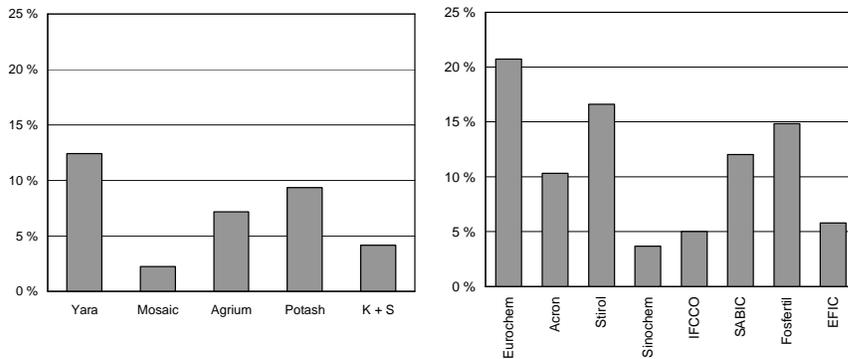


Figure 10. Net Income / Total Assets (%): Annual average during 2004-2007.

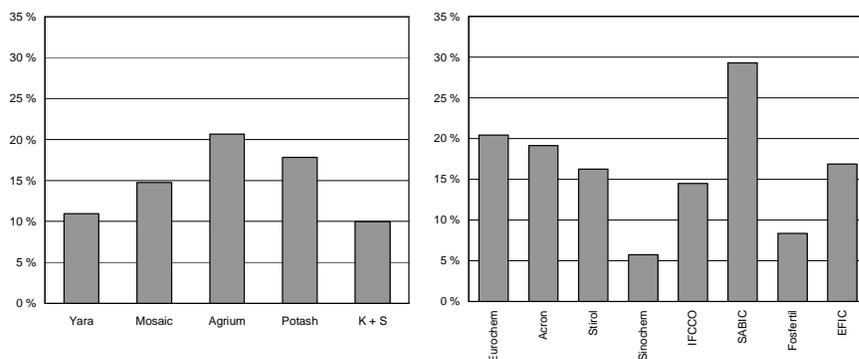


Figure 11. Growth of turnover: Annual average during 2004-2007.

According to the figures, the challenger firms have been more profitable during the past years than the top 5 fertilizer firms. The average operating income/turnover ratio for top five firms is 12 % and for challenger firms 22 %. Similarly, the average net income/total assets ratio is 7.5 % for the top 5 firms and 13 % for the challenger firms. The average rate of growth in turnover is high in both groups - about 15 % - indicating positive development in the fertilizer market during recent years.

We can summarize these observations by noting that the world's five largest fertilizer companies face strong competition and are challenged by firms located mainly in regions having relatively cheap natural gas.

#### 4. Conclusions

According to our analysis, fertilizer consumption pattern is changing. Fertilizer consumption is declining or remains stable in Western Europe and North America. At the same time there is a rapid increase in consumption especially in China and India. The changes in demand pattern direct investments on fertilizer production capacity, and thus effects regional supply-demand balance. Overall, nitrogen fertilizer production has increased in recent years mainly in East and Central Asia and declined in North America. The other main factor directing investments in nitrogen fertilizer production is the availability of natural gas. Transportation of fertilizers is relatively cheap compared to natural gas. Thus, investments on nitrogen fertilizer plants have been directed to those areas with low-cost natural gas.

Urea is the most traded fertilizer in the world markets. Main urea trade-flows origin from the Black Sea region to Europe, Asia and Northern Africa, and from Near East to North America, South Asia and Sub-Saharan Africa. In recent years, urea trade-flows have concentrated both on exports and

imports. Five largest exporting regions have steadily increased their share of all urea exports during the ten year period of 1996-2006.

Changing consumption patterns opens opportunities also for structural changes in the markets. Our analysis suggests that relatively smaller firms can now better compete with the giants in the fertilizer market. Intensive global competition also forces large firms to examine their business practices and to evaluate how to meet the global challenges in the industry. Biggest challengers are able to compete with the world's leading fertilizer companies in terms of profitability and growth. We can conclude that the leading firms are also hard-pressed to become more efficient in this highly competitive industry.

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