Challenges and opportunities for the fertilizer industry: fertilizers and agricultural production

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Introduction

There is some concern about the capability of world agricultural production to keep pace with the growth of world population. Food and nutrition security, the main agricultural goal, is not just a matter of ensuring adequate food supplies but also ensuring their availability and stability, accessibility and affordability. As of 2010, world population is at 6.8 billion and is projected to grow by close to 1 per cent annually between 2007 and 2016 and reach more than 9 billion by 2050 (US Census Bureau, 2010) with the majority of humanity living in urban areas. The daunting task for the agriculture sector is to produce the needed food, feed, fibre and biofuels for the growing population in a manner that will protect the environment, preserve biodiversity, and mitigate climate change, all at the same time. Because of the constraints on the expansion of land and water resources, growth in future food supply predominantly depends on agricultural intensification.

Agricultural productivity and factors influencing production

The factors affecting agriculture are constantly evolving. These include land use changes, which affects not only the quantity and quality of land available for cultivation, but also impacts how nutrients might be filtered out of water supplies by wetlands. The distribution of water for agriculture is changing, and the water itself may be subject to declining quantity and quality, through salinization or contamination because of changing weather patterns and human activities. Multiplying demands on agriculture have resulted to the use of high-yielding varieties that progressively deplete the soil’s native nutrient pools. Changing weather patterns, soil degradation and erosion, rural depopulation and other factors are changing the context in which agriculture is carried out.

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Global agricultural production and consumption are seen shifting from developed to the developing economies, particularly in emerging and middle income countries, driven by stronger population growth and rising incomes. The average global agricultural growth rate of 2 per cent from 1999-2008 is projected to decrease to 1.7 per cent by 2009-2018 (FAO, 2009), which is very close to the growth rate of world population of 1.5 per cent (US Census Bureau, 2010). The question remains, will we be able to meet the food, feed and biofuel requirements of the growing population?

**Fertilizer demand**

Erisman et al. (2008) estimated that the number of people supported per hectare of arable land increased from 1.9 in 1908 to 4.3 persons in 2008 and further estimated that 48 per cent of the world population is fed because of manufactured nitrogen fertilizers by the Haber-Bosch process.

Fertilizer demand is indeed closely related to cereal production. Global cereal production was 866 million tonnes in 1961 and rose to 2.2 billion tonnes in 2010. Similarly, global fertilizer use increased almost six fold during the same period, from 32 Mt in 1961 to 170 Mt in 2010/11. In the next five years, global fertilizer consumption is projected to increase at a yearly rate of 2.5 per cent to reach 188 Mt nutrients in 2014/15, with some variable increases between nutrients (1.8 per cent for N, 3.1 per cent for $\text{P}_2\text{O}_5$ and 4.3 per cent for $\text{K}_2\text{O}$.)

Fertilizer consumption in 2010/11 is projected to increase in all regions except West Asia. East and South Asia, and Latin America would contribute largely to the increase in world demand for N, while highest growth in P and K demand would occur in East Asia. By 2014/15, the bulk of the increase in world demand would come from Asia and to a lesser extent from Latin and North America. East and South Asia together would account for 60 per cent of the total growth in world demand in the next five years.

**Drivers of fertilizer demand**

The factors driving fertilizer demand include continued world population growth, increased income, and resulting diet diversification, biofuel development, limited immediately available additional arable land, increased recycling of organic nutrient sources, and improved nutrient use efficiency, among others.

In many developing countries, especially China, rising income has led to changes in diet diversification. People are requiring more meat, dairy, fruits and vegetables, vegetable oil and less cereals and pulses, impacting the crop mix. Increased production of meat will require more grain and, at the same time, cash crops compete for land and water with grain crops.
It is imperative to optimize agricultural production per unit of land in order to meet the demands of the growing population. According to FAO (2009), some 1.6 billion ha (found mostly in Africa and Latin America) could be added to the current 1.4 billion ha of cropland. However, bringing more marginal land into production will involve considerable investment with probably lower yield levels and subsequent social and environmental costs. Water may become more of a constraint than land availability for agriculture. The increasing competition for water in non-agricultural uses, rising costs of irrigation projects and the likely adverse environmental effects contribute to limit the rate of expansions of irrigation particularly in the developing countries.

Improving the efficiency of fertilizers, nitrogen in particular, increases agricultural productivity and minimizes the negative impacts on the environment. N efficiency has increased over the past two decades in most of the developed countries but needs to improve in the developing countries, particularly in China and India, the world’s top fertilizer consumers.

Mineral sources of phosphorus and potassium nutrient were cut back by farmers during the recent economic downturn. As a result, the soil’s natural reserves have been mined and the recycling of organic P and K resources has gained momentum.

The direct impact of biofuel production on fertilizer demand can be assessed based on fertilizer use by crop estimates and the share of the crop output that serves as biofuel feedstock. A total of 5 Mt of plant nutrients was applied to biofuel crops in 2008/09 accounting for 3.2 per cent of the world fertilizer consumption. Nutrient wise, some 3.0 Mt N, 0.9 Mt P\textsubscript{2}O\textsubscript{5} and 1.1 Mt of K\textsubscript{2}O were applied on biofuel crops representing 3.0, 2.5 and 4.8 per cent of the global N, P\textsubscript{2}O\textsubscript{5} and K\textsubscript{2}O consumption, respectively. According to OECD and FAO, world ethanol production is projected to increase firmly (+85%) in the decades to come, reaching 148.5 billion litres in 2018, and the world biodiesel output would more than double in the same period, to 43.8 billion litres. This translates into an increasing need for feedstock such as maize, sugarcane and rapeseed.

Fertilizer demand in the future will be further influenced by the world economic and financial context, the evolution of policy priorities in China and India, the outcome of the discussions on the environmental impact of biofuels and the evolution of crop prices and currency exchange rates.

**Fertilizer Supply**

The fertilizer industry is in the center of agricultural productivity and is continuously challenged with supplying the farmers enough quality fertilizers at the right time and at affordable prices.
Despite the depressed economic and financial conditions, sluggish international demand and the decrease in international fertilizer prices, world capacity in 2009 moderately increased. Key factors that have been influencing global fertilizer supply include energy prices, government trade policies, and environmental concerns.

In 2009, world aggregate nutrient production dropped 8 per cent to 194 Mt, the lowest level since 2003. Potash and phosphates production have been severely affected in contrast to nitrogen production which rose moderately. Global capacity increased in key exporting regions but at modest rates.

In the short term, world supply and demand conditions are expected to include resilient annual potential surpluses of phosphate rock, potash and urea due to the emergence of large capacities in the main exporting regions. During the next five years, market conditions for phosphate fertilizers i.e. DAP and merchant phosphoric acid, merchant ammonia and sulphur are seen as relatively balanced due to firm demand growth and a gradual increase in capacity.

**Capacity and balance outlook**

**Nitrogen**

IFA projects that between 2009 and 2014 global ammonia capacity will increase at an annual growth rate of 4 per cent with a net expansion of 37.4 Mt NH₃ over 2008. About 65 new plants are under construction 23 of which are in China alone. Much of the growth in ammonia capacity is associated with new urea capacity since almost 90 per cent of the increase of N production comes from urea. The global nitrogen supply/demand balance is projected to show a potential surplus of about 4.7 Mt N in 2010 that will expand to 16.7 Mt N in 2014.

**Phosphorus**

By 2014, world phosphate rock capacity is projected to reach 228 Mt from 190 Mt in 2009, as a result of expansion in existing operations, new mines opened by current producers, and new capacity by emerging suppliers. Phosphoric acid capacity will increase by a net 9.3 Mt to 55.5 Mt P₂O₅ between 2009 and 2014 coming mostly from China, Morocco and Saudi Arabia, Jordan and Tunisia. However, most of these are earmarked for domestic markets. No new tonnage of non-committed merchant grade acid capacity is expected to be available before 2014. The medium-term global phosphoric acid supply/demand balance shows a marginal potential surplus of close 2.0 Mt P₂O₅ in 2010 through 2013, but expanding moderately thereafter with the commissioning of announced projects in Africa and West Asia.
In the near term, 40 new units of MAP, DAP and TSP are projected to come on stream, with the global capacity increasing by 28 per cent over 2009, to 42 Mt P$_2$O$_5$ in 2014. Three-quarters of this 8.2 Mt net increase will be driven by new DAP capacity. The bulk of new projects will occur in P resource-rich countries, with about half of these units being constructed in China. The global DAP supply/demand balance shows a marginal potential surplus, averaging 2.5 Mt annually through 2014 when assuming a sustained operating rate of 65 per cent of capacity. Therefore, during the period 2010 to 2014, it is estimated that all new supply additions would be absorbed by the growing demand requirements.

Potassium

Carry-over stocks from the previous year were a significant source of potash supply in many countries in 2009, thus global potash sales dropped considerably by 8.6 per cent over 2008. IFA survey on potash capacities revealed that a significant slow-down is anticipated in capacity growth between 2009 and 2014 due to widespread delays in virtually all new projects. However, global potash capacity is forecast to increase from 41.6 Mt K$_2$O in 2009 to 54.7 Mt in 2014. The additional capacity of 13 Mt will come mostly from Canada and Russia. New tonnage is also expected to emerge in Argentina, Chile, China, the Republic of Congo, Israel, Jordan and Laos. The global supply/demand balance for potash shows a slight reduction of the potential large surpluses in the short term but expanding after 2012. Further delays would balance the growth in supply with the projected increase in potash demand.

Opportunities and industry initiatives

In order to meet the simultaneous challenges of ensuring world food and nutrition security while mitigating unwanted impacts on the environment, the global fertilizer industry is undertaking a number of initiatives:

- Increasing and modernizing fertilizer production capacities to reduce environmental footprint at production sites. The move towards higher capacity plants has helped implement more efficient technologies as capacity upgrades offer a cost-effective opportunity to install better performing technology and reduce unwanted emissions.

- Developing standards and performance measures for the promotion of efficient, safe and secure production, storage, and transport of plant nutrients in a sustainable manner.
Improving fertilizer use efficiency. The industry is developing products with built-in enhanced efficiency together with promoting fertilizer best management practices aimed at using the “right product, at the right rate, at the right time and the right place”.

The initiative on fertilizer use and human health will enable better understanding of the positive and negative impacts of fertilizer use on human nutrition. To help alleviate the problem of malnutrition, improving nutrition security through micronutrient applications is undertaken in partnership with HarvestPlus.

The “Farming First” initiative is a call for food security and sustainable agriculture to the UN Commission on Sustainable Development. It helps stakeholders focus on the common goal of ensuring food security; encourage increased transparency on the funding priorities, and stick to collaborative actions that are clear and well coordinated.

The Africa Forum is an IFA regional body advocating greater fertilizer use to improve soil fertility, agricultural production, human nutrition and alleviate poverty in Africa.

The water management initiative is aimed at developing and promoting strategies and best management practices that improve efficiency of water and fertilizer/nutrient use.

The significant risks and opportunities that climate change present for agriculture, food supplies and the global fertilizer industry, create an imperative for the industry to contribute to the mitigation and adaptation in the context of achieving a more sustainable path to global food security.

Improving the “last-mile delivery” of products and knowledge in developing countries is a major challenge to our industry if one wants to achieve a meaningful impact of the fertilizer best management practices. It requires wide partnerships with multiple stakeholders.

**Conclusion**

It is clear that the fertilizer industry has a great challenge of meeting the needs of the growing population, at the same time protecting the environment, preserving biodiversity and mitigating climate change, but the challenge can be dealt with and even offer opportunities.
References


