Adapting to new driving forces and agricultural production practices: challenges for the fertilizer industry

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Abstract
Soil plays a basic role in the maintenance of balanced ecosystems, the preservation of landscapes, biodiversity conservation, and, of course, agriculture. Agriculture provides food, feed, bioenergy, clothing and shelter for a growing population. In 2008 the world was threatened with food insecurity, raising public awareness of the fragility of the food production system. The food crisis overlapped with the financial crisis and global economic downturn. Today the challenges for agriculture are to adapt rapidly enough to new driving forces, and to modify production practices in order to mitigate and adapt to climate change – and minimize any other negative impacts on the environment – while ensuring food and nutrition security. The fertilizer industry, at the centre of agricultural productivity, has the responsibility of providing the right sources of plant nutrients at the right time and place, as well as transferring knowledge to farmers on how to use this input efficiently and effectively.

Keywords: food security, agricultural productivity, fertilizer consumption, fertilizer use, fertilizer supply, fertilizer industry, driving forces, agricultural production practices

Introduction

Agricultural productivity is determined by a number of factors that are constantly evolving, including land use and the availability of water (which is affected by both human activities and changes in weather patterns). The rapidly increasing demand for agricultural products globally has necessitated the use of high-yielding varieties that deplete native pools of nutrients if these nutrients are not regularly replenished. Intensification of agriculture has led to changes in cropping patterns, improved crop varieties, and more efficient water management and use, among other impacts.

New driving forces

Agriculture has evolved since the 1970s. Today the following are key drivers:

- *Continuing population growth: The world population is projected to grow by 1.08% annually* between 2007 and 2016. More than 1 billion people are currently undernourished. More than 3 billion suffer from micronutrient deficiencies, or so-called "hidden hunger".

- *Income growth in developing countries:* Greater consumption of meat, fish, vegetable oils, sugar, fruits and vegetables is expected to continue in developing countries due to population growth and rising incomes (OECD-FAO, 2009).

- *Higher fuel and energy costs:* Partly in response to oil price spikes, the development of biofuels (including ethanol and biodiesel) has increased in the United States, Brazil, the EU and elsewhere. Biofuel crops can contribute to meeting future energy needs, but realistic assessments of the challenges and costs involved in their production indicate that major issues remain to be addressed.

- *Limited immediate availability of additional arable land:* Agricultural transformation in the 21st century will involve land use intensification and better management of off- and on-farm sources of plant nutrients. 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 in 2008, mainly due to use of manufactured nitrogenous fertilizer.

- *Climate change:* Unpredictable weather events, including typhoons and flooding, and the drought conditions prevailing in several regions create water stress. Shifts may therefore occur in production areas, with significant impacts on world grain production, fertilizer use and overall agricultural productivity.

World agricultural situation and outlook

World cereal output is projected to reach 2.24 billion tonnes (Bt) by 2010 in order to meet projected consumption of 2.23 Bt, a 1.8% increase over the 2008/09 level (FAO, 2010). Cereal production needs to more than double again by 2050 to satisfy the needs of a growing population. According to the International Grains Council (IGC, 2010), maize production in 2010 is expected to rise based on increased planting intentions and improved weather conditions in maize growing regions. The global area planted to maize is expected to increase by 2% to a record 156 million hectares. This would offset anticipated lower wheat plantings and output. Rice production in 2009/10 decreased by 1.5% to 452.5 Mt from 459.5 Mt in 2008/09, while utilization remains high at 453.8 Mt, a 1.8% increase from the previous year (445.9 Mt). In 2009/10 it is projected that 42% of total domestic maize use in the United States will be for ethanol production. It is also projected that production of ethanol from maize will expand in the United States in the next two years, but at a much slower pace than in the past. Production of ethanol from sugarcane is rising steadily in Brazil, encouraging Brazilian farmers to increase the area planted to cane and cane yield. Due to attractive sugar prices, however, ethanol production from sugarcane may temporarily decline in 2009/10.

World fertilizer situation and outlook

Fertilizer is a world commodity and is subject to supply/demand and market fluctuations. Aggregate world fertilizer (nutrient) demand in 2009/10 is projected to slightly recover by 1.0% compared with the previous year, from 156.4 Mt to 158 Mt. Fertilizer demand has started to recover in 2009/10 for N and P_2O_5 by 1.6 and 3.0%, respectively, while K_2O is still down by 4.5%. By 2010/11 total nutrient demand is forecast to reach almost 166 Mt, a recovery of about 5% from the previous year with increases of almost 14% in potassium, 6% in phosphorus and almost 3% in nitrogen (Heffer and Prud'homme, 2009). Total fertilizer demand in 2010/11 is forecast to continue to grow in South Asia and to rebound in North America, West Asia and East Asia. Demand would evolve only marginally in the remaining regions: Eastern Europe and Central Asia, Africa, Latin America, and Western and Central Europe.

Fertilizer use by crop in 2006/07 shows that major cereal crops together consume about 50% of all fertilizers with magnitudes of 15.9% for maize, 15.2% for wheat and 14.6% for rice, while other cereal crops represent 4.6% of the world total. High usage on fruits and vegetables, at 27.4 Mt or 17% of total world fertilizer consumption, is observed. Oil crops together account for 9.3%, cotton for some 3.6% and sugar crops for some 4.3% of fertilizer use, with the remaining 15.5% for other crops (Heffer, 2009).

Weakness in demand in 2009 impacted global nutrient production and the industry's operating rates, though at different intensities depending on the nutrient. Ammonia production was rather stable, while urea output expanded moderately. Phosphoric acid production declined marginally in 2009, but production of phosphate rock dropped. Potash production plunged in 2009 due to a combination of depressed demand worldwide and large stock carry-over inventories in key importing countries.

The supply and demand balances for nitrogen and urea are expected to decline to 8 Mt N in 2010 while, for phosphoric acid, a potential surplus of 6 Mt P_2O_5 in both 2009 and 2010 is foreseen. The derived potash supply/demand balance in 2010 is down to 11 Mt K_2O in 2010, influenced by weak demand for

potash. The situation in 2010 would see a trend reversal compared to 2009, with a moderate 4.9% growth in global demand and a strong 7% rebound in the total sales of the mainstream products.

Industry challenges and initiatives

Ensuring that adequate supplies of plant nutrients are available is the fertilizer industry's primary and most direct contribution to meeting the challenges faced by agriculture. To provide this service in the most sustainable manner possible, the industry is committed to continually improving product properties, ensuring that suitable products are available to meet farmers' specific needs, and developing methods to better match nutrient supply and crop requirements:

1. *Improving nitrogen fertilizer use efficiency.* The fertilizer industry supports implementation of best management practices through the search for techniques to predict or diagnose nitrogen requirements accurately, and through involvement in advisory and educational initiatives directed at farmers. It advocates the widespread adoption of fertilizer best management practices (FBMPs) within the 4R Nutrient Stewardship Framework – providing the right product(s) at the right rate, the right time and in the right place.

2. *Initiative on climate change*. The risks and opportunities that climate change presents for agriculture create an imperative for the international fertilizer industry to contribute to mitigation and adaptation, with the objective of achieving global food security sustainably. In 2007 the International Fertilizer Industry Association (IFA) established a task force on climate change. In 2009 the white paper *Fertilizer, Climate Change and Enhancing Agricultural Productivity sustainably* and the report *Greenhouse Gas Budgets of Crop Production – Current and Likely Future Trends* were published. IFA encourages its members to minimize direct emissions from production, to foster the reduction of emissions related to fertilizer use and, where possible, contribute to the creation or expansion of carbon sinks.

3. *Product stewardship.* The fertilizer industry aims at improving the efficiency of the production, storage, transport and use of plant nutrients sustainably. Through IFA, the industry develops efficiency, safety and security standards and performance indicators. Technical knowledge and the adoption of safety, health and environment (SHE) principles by members are encouraged, as well as interaction with relevant organizations and legislative bodies in order to raise awareness and enhance mutual understanding of global fertilizer production issues.

4. *Fertilizer use and human health.* IFA continuously supports the concept of "farming for health". This initiative is aimed at assisting world agriculture to meet both food and nutrition security objectives through producing enough nutritious food to supply all the nutrients essential for human health.

5. *Africa*. IFA has established a regional body (the IFA Africa Forum) to stimulate fertilizer use for improved soil fertility, agricultural production and human nutrition and to alleviate poverty in Africa. It provides a platform for the exchange of views and expertise on key issues. It also facilitates effective communication with key interlocutors, while contributing to greater awareness of the positive role of fertilizers and thus to increased agricultural productivity by African farmers.

6. *Effective last-mile delivery*. IFA recently launched an initiative to foster the adoption of FBMPs in developing countries. Agricultural research results become valuable only when farmers adopt them, leading to improvements in the quality and yield of their crops, a safer environment and a better return on investment. The fertilizer industry recognizes that its efforts alone are not sufficient to ensure widespread adoption of FBMPs. It is also important to develop multi-stakeholder partnerships.

7. *Fertilizer use and water management.* Water will become increasingly scarce due to competing uses, exhaustion of groundwater reserves and climate change. Water availability, which affects fertilizer use and its profitability, is a key driver of fertilizer demand. Proper management of plant nutrients contributes to more efficient water use. The new IFA initiative on fertilizer use and water management aims at developing and promoting strategies and practices to simultaneously enhance fertilizer and water use efficiency.

Conclusion

The challenges for agriculture are to adapt rapidly enough to new driving forces, and to modify production practices in order to mitigate and adapt to climate change and minimize any other negative impacts on the environment – while meeting the food, feed, fibre and energy demands of a growing world population and helping rural households to improve their living standards.

Better agricultural efficiency can be achieved through: obtaining higher yields on currently cropped land; restoring the productive capacity of degraded land and water supplies; reducing wastes and losses in the production process; and improving the efficiency of use of water, fertilizers and other agricultural inputs.

Best management practices (BMPs) are needed which include: maximizing the recycling of organic nutrient sources; matching nutrient/fertilizer applications and crop needs; and using barriers to prevent the movement of nutrients out of the field.

The imperative for *increasing agricultural research* has never been greater, in that: the number of hungry people in the world is increasing at an alarming rate; nutrition security is a growing challenge; the amount of good arable land is decreasing due to urbanization and desertification, among other factors; energy costs are again increasing; water use efficiency and management urgently need to be addressed; fertilizer use efficiency can be further improved; environmental concerns are growing; and climate change is upon us.

The challenge of *effective last-mile delivery* includes: effective (customized and real-time) transfer of knowledge and technology to farmers, and the urgent need to identify the most effective means of transferring best technologies to farmers, particularly in the developing countries of Asia and sub-Saharan Africa.

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