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Challenges for Plant Nutrition Management from the Fertilizer Industry's Viewpoint

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Introduction

Manufactured fertilizers play a key role in intensive agriculture. Food production goals cannot be met without improved varieties, crop protection products, irrigation and fertilizers. Currently, it is estimated that nitrogen fertilizers help to feed 48 per cent of the world population (Erisman, *et al.*, 2008). However, the number of hungry and malnourished people in the world has risen to 1 billion in 2009, the majority in the developing countries of Asia and the Pacific (FAO, 2009). It is also estimated that the need for food, particularly the three major cereals, will rise at a compound annual rate of 1.29 per cent from 1995 to 2025, based on the IMPACT model developed in 2002 by Rosegrant, *et al.* (Cassman, 2008). Increasing yields from existing farmland is the only sustainable option if we are to prevent further destruction of biodiversity and negative environmental impacts (in particular, CO₂ emissions related to land use change). To meet these challenges, the importance of the role of plant nutrients and their efficient management cannot be overemphasized.

World cereals situation

The major cereal crops – wheat, maize and rice – contribute more than 50 per cent of all human energy intake, whether they are ingested directly or indirectly as animal feed (Cassman, 2008). All cereal crops consume about 50 per cent of the world’s fertilizers (IFA, 2009). In 2009, world cereal output is expected to be down by 1.70 per cent, to 2.19 billion metric tonnes (Bt) (USDA, 2009). Initial projections are that world cereal consumption will increase only modestly because of the economic downturn. The 2009 world cereal output is expected to match demand in 2009/10. The stock-to-use ratio for wheat and rice is seen as increasing at the end of the 2009/10 campaign to 28.21 and 21.31 per cent, respectively. The ratio for coarse grains would contract to 16.40 per cent (Table 1).

In the medium term, demand for all agricultural commodities will remain strong as the world population continues to increase and diets diversify to include more fruits, vegetables, fish and meat products. Bioenergy requirements will also contribute to this strong demand.

**Table 1. World Cereal Production, Use and Stock-to-Use Ratio
(USDA, 2009)**

	2007/08	2008/09(e)	2009/10 (f)	Change (per cent)
Production (Total –Mt)	2 121.48	2 226.26	2 188.84	-1.70

Wheat	610.93	682.32	656.48	-3.93
Coarse grain	1 077.17	1 099.21	1 083.37	-1.40
Rice (milled)	433.38	444.72	448.98	+0.95
Use (Total –Mt)	2 101.14	2 144.90	2 177.01	+1.47
Wheat	616.71	636.17	642.56	+0.99
Coarse grain	1 056.20	1 072.70	1 091.04	+1.68
Rice (milled)	428.23	436.03	443.42	+1.66
Stock-to-Use Ratio (Total - %)	17.20	20.65	20.88	
Wheat	19.65	26.30	28.21	
Coarse grain	15.16	17.40	16.40	
Rice (milled)	18.73	20.39	21.31	

e: estimate; f: forecast

World fertilizer consumption

Fertilizer is a world market commodity. It is subject to supply/demand and market fluctuations. After continuously increasing for several consecutive years, fertilizer consumption, like that of other commodities, has been affected by the economic downturn since mid-2008. Aggregate world fertilizer demand in 2008/09 is projected to decrease by 5.1 per cent compared with the previous year, from 168.1 to 159.6 Mt nutrients. On a per nutrient basis, N, P₂O₅ and K₂O fertilizer demand is estimated to be down by 1.6, 7.3 and 14.4 per cent, respectively (Table 2). These declines are not only harming the fertilizer industry, but may also have a negative effect on crop production and food security.

Table 2: Historical Global Fertilizer Consumption and Short-term Forecast (Mt nutrients) (Heffer and Prud'homme, 2009)

	N	P ₂ O ₅	K ₂ O	Total
06/07	97.4	38.1	26.9	162.4
07/08	101.0	38.8	28.3	168.1
08/09 (e)	99.4	36.0	24.3	159.6
<i>Change</i>	<i>-1.6%</i>	<i>-7.3%</i>	<i>-14.4%</i>	<i>-5.1%</i>
09/10 (f)	102.0	38.1	25.3	165.4
<i>Change</i>	<i>+2.6%</i>	<i>+6.1%</i>	<i>+4.1%</i>	<i>+3.6%</i>

Five regions accounted for almost 90 per cent of world fertilizer consumption in the fertilizer year 2007/08: East and South Asia together accounted for 56 per cent (39 and 17 per cent, respectively), North America for 13 per cent, Western and Central Europe for 11 per cent, and Latin America and the Caribbean for 10 per cent. Fertilizer consumption is determined by the size of the population, income per capita, availability of fertile land and water, climatic conditions, environmental regulations, production of biofuels, technological developments, and accessibility to the world market.

In the medium term, the driving factors for agricultural production, namely, continued world population growth, income growth in developing countries, rapid development of biofuels, limited immediately-available additional land, increased recycling of organic nutrient sources

and improved nutrient use efficiency, among others, remain unchanged. The current economic downturn, however, is changing the short-term impact of some of these factors on world fertilizer demand.

In view of the prevailing strong agricultural market fundamentals and the anticipated progressive recovery of the world economy, world fertilizer demand is seen as slightly rebounding in 2009/10 (+3.6 per cent) to 165.4 Mt, with growth rates of 2.6 per cent for N, 6.1 per cent for P₂O₅ and 4.1 per cent for K₂O. In the medium term, world fertilizer demand is seen as progressively recovering. It is projected to increase by 2.3 per cent annually on average, to reach 186.8 Mt by 2013/2014. Demand for N, P₂O₅ and K₂O is projected to reach 111.1, 44.3 and 31.4 Mt, respectively. The bulk of the demand will still come from Asia and, to a lesser extent, Latin America. East and South Asia are projected to account for 62 per cent of total growth in demand.

Fertilizer use by crop

According to the latest data for 2006-2006/07,¹ fertilizer application to cereals would amount to 81.0 million metric tonnes (Mt) nutrients. This is 50.2 per cent of total world fertilizer use, considerably below the “conventionally agreed” figure of 60 per cent. This can be explained by high usage on fruits and vegetables, estimated at 27.4 Mt or 17.0 per cent of total world fertilizer consumption. Fertilizer applications to the three main cereals are of similar magnitude: 15.9 per cent for maize, 15.2 per cent for wheat and 14.6 per cent for rice, while other cereal crops represent 4.6 per cent of the world total. Oil crops together account for 9.3 per cent of world fertilizer consumption (15.0 Mt), with market shares of 3.4 per cent for soybean, 1.5 per cent for oil palm and 4.4 per cent for other oilseeds. Cotton accounts for some 3.6 per cent of the fertilizer applied worldwide, whereas its use on the other fibre crops is negligible. Sugar cane and sugar beet together account for some 4.3 per cent of world fertilizer consumption. Other crops account for the remaining 15.5 per cent (Heffer, 2009).

Industry's capacity to meet demand

Between 2000 and 2007, the world fertilizer industry increased its overall operating rates, culminating in 2007 when producers operated at an average of 97 per cent of capacity in the three main nutrient segments. By the end of 2007 and entering 2008, the industry was running at close to its maximum effective capacity. This explains the very tight market conditions prevailing during the first half of 2008. If global fertilizer demand had been sustained at the same level in the second half of 2008, it is likely that there would have been a shortage of potash, phosphate and urea supply.

From 2009 to 2013, nitrogen capacity developments will be shaped by prospects for fertilizer demand growth, input differential costs, downstream developments and export opportunities.

¹ 2006 for countries with fertilizer consumption statistics in calendar years, and 2006/07 for those with statistics in fertilizer years.

The global nitrogen industry is expected to improve its energy efficiency while reducing its carbon footprint and replacing aging facilities. The global nitrogen supply/demand balance shows a potential surplus exceeding 6.6 Mt N in 2009, rising to 13 Mt N in 2013. The potential surplus in 2009 is equivalent to 5 per cent of global supply, compared with 8 per cent in 2013. There is also the prospect of rising and sustained surpluses in the phosphate and potash sectors unless global demand recovers more quickly and strongly than anticipated, or unless major new capacity projects experience significant delays.

The fertilizer industry's response to current and forthcoming challenges

A year ago the focus was on commodity prices and food security. Today these issues are overshadowed by the economic downturn. However, a potential food crisis is still looming and the fertilizer industry and its partners should be ready to respond. To meet the challenges of ensuring world food and nutrition security, and at the same time mitigating negative impacts on the environment, the global industry (together with scientists and other relevant partners) has embarked on a number of initiatives such as:

- improving the efficiency of fertilizer manufacturing plants;
- improving nutrient use efficiency (e.g. balanced fertilization and use of micronutrients; site-specific nutrient management; development of products with built-in enhanced efficiency, and fertigation);
- improving the availability and affordability of fertilizers in Africa.

Fertilizer Best Management Practices (FBMPs)

The objective of FBMPs is to manage the flow of nutrients in such a way as to produce enough affordable and healthy food while sustaining soil fertility, protecting the environment, conserving natural resources, and creating an atmosphere of trust with consumers and policy makers concerning food production. The principle of fertilizer best management is simple: using the right product(s) at the right rate, the right time and the right place. The simplicity of this principle means that it can be adapted according to the farmer's access to technology. But implementation is more complicated because of the many factors that must be taken into account.

FBMPs entail answering the question "Best to achieve what?" Maximizing and stabilizing yields, reducing greenhouse gas emissions, limiting nutrient leaching, enhancing the nutrient density and balance of food products, or something else? Ideally, enhanced practices would meet all of these challenges. In reality, there are trade-offs between two or more of them. Therefore, we need to determine the highest priorities and achieve the greatest net benefit possible.

The purpose of IFA's Fertilizer Best Management Practices initiative is to encourage the dissemination of FBMPs that have been developed and assessed within a scientifically valid framework. The initiative is concerned, in particular, with promoting FBMPs in developing-

agriculture countries, where data and their application are currently weakest. Nevertheless, even in some developed countries much of the data underlying the best agricultural practices currently being disseminated are outdated. One challenge will be to ensure that adequate data are available to establish a scientific foundation for the FBMP recommendations.

Conclusion

The world population is steadily increasing, as is demand for food, fibre, feed and bioenergy. Pressure on agricultural productivity is becoming more severe, especially in developing countries. World agricultural production can grow in line with demand, provided that the necessary national and international policies are put in place to promote agriculture (FAO, 2002). Policies supporting nutrient additions should primarily aim at food security objectives, while at the same time paying more attention to the effects of agriculture on the environment and to the ecological and agronomic processes that produce these environmental effects. As intensive farming is a more environmentally sustainable approach to achieving increased agricultural productivity, compared with opening up new lands for agriculture, the important role of plant nutrient management comes into play. Recycling of organic nutrient sources, and more efficient use of nutrients, are not only means of protecting the environment. They can also improve the profitability of farming and contribute to meeting the food security challenge.

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