VM Group research for Fortis Bank Nederland

Geopolitical Analysis Quarterly

June 2010

Fortis Bank Nederland

THE FERTILISER COMPLEX: FUTURE RISK

VM GROUP

Geopolitical Analysis Quarterly is produced as part of a joint venture between Fortis Bank Nederland and VM Group

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Introduction

Fertiliser is a leading candidate for the title of the 21st century's metacommodity, in that fertiliser supply and demand criss-crosses several otherwise quite distinct commodity sectors, including not just agricommodities but also energy and mining. The production and use of fertiliser involves some aspect of every part of the commodity complex, whether agricultural crops in the form of food, feedstock for biofuels or animal feed. Natural gas, crude oil or electricity are required to produce the various types of mineral fertiliser. Extracting phosphates and potassium involves mining and minerals processes that are commonly associated with base and other industrial metals.

The fortunes of fertiliser are therefore clearly tied to those of all other major categories of commodity, in terms of price, demand and supply. The consequence is that the variables that govern, for example, the price of crude oil feed into the fundamentals of fertiliser. Nitrogen fertilisers, which are produced with natural gas, have a critical relationship with natural gas and crude oil prices because both are input costs. Fertiliser also increasingly has a relationship with carbon prices, because as international and national legislation is introduced which commits major economies to reducing their use of fossil fuels, the demand and the price of both crude and natural gas will be affected.

The long-term fertiliser market will be moved by all these interactions with other commodities, as well as fertiliser-specific fundamentals. But the most important drivers for fertiliser are demographic change and agricultural support, in the form of subsidies and biofuel mandates.

In advanced economies fertiliser costs are a relatively tiny proportion of the cost of food – the Fertilizer Institute, an American industry association, says that in the US fertiliser costs comprise just 2% of the cost of producing a loaf of bread, and only 3% of the consumer price for a unit of chicken, beef or pork. Yet such is the changing nature of our society that fertilisers have become relevant not just to food production but also long-term energy supply and demand, thanks to the emergence of biofuels.

On current trends the world faces a serious arable land supply crunch. The UN estimates that the global population will hit 9.1bn by 2050, but the arable land available will remain at best static; desertification and urbanisation could actually decrease arable land availability. Economic growth currently looks likely to be at a much slower pace than expected pre-recession, except in the emerging economies, where the rate of economic growth has barely stumbled. The Food and Agricultural Organization (FAO) forecasts that food production will have to grow by 70% (v. average 2005-2007 levels) to meet the demands of a global population growth of 40% from today by 2050. With fertiliser currently used in the production of as much as 60% of global food supplies, it is inevitable that fertiliser demand will grow too.

The twinning of fears about clean and secure energy have combined to make biofuel feedstocks a key crop in some advanced economies like the US and other agricultural powerhouses such as Brazil. If the current trend in the use of biofuels[1] continues, there will be increasing competition between crops grown as biofuel feedstocks and those grown for human consumption as food. Mandates imposing higher levels of biofuel use and/or lower levels of greenhouse

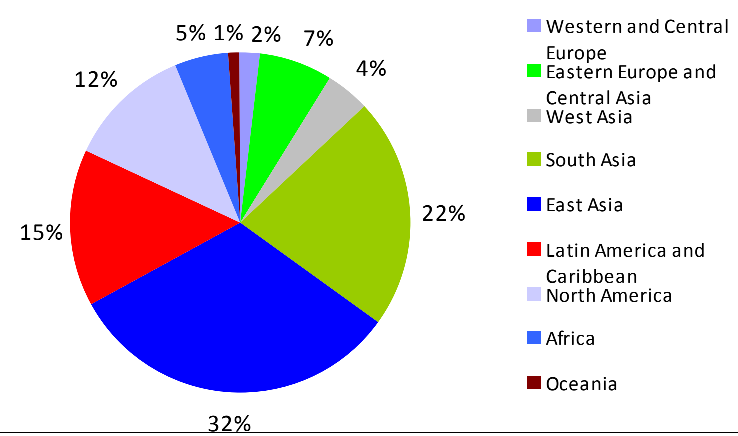
[1] Biofuels are renewable, combustible fuels derived from biomass. The two main types of biofuel are ethanol – which is made from food crops or plant cellulose – and biodiesel. Biodiesel can be made from either vegetable oil or animal fat feedstocks, which are chemically transformed into diesel fuel.

emissions in the US and the EU will require progressively higher supplies of biofuels in years ahead. Agricultural subsidies' support, either directly to farmers as in the EU and the US, or in the form of support to fertiliser companies (in India for example), help promote the use of fertiliser and are unlikely to be abandoned, not least for political reasons.

With so many of the resources required for farming in short or dwindling supply in the longer term, there will be increasing pressure on the supply of agricultural crops. This will have to be met in part by improving crop yields. Technological developments might be able to deliver greater volumes, but, in all likelihood, improving agricultural production will hinge on greater fertiliser use.

The fertiliser industry is today in a state of flux. The fact that fertiliser prices have not returned to pre-recession lows testifies to the fact that there has been a paradigm shift in the supply-demand chain for fertilisers. In the past, major fertiliser importers (such as China) have used their bulk-buying clout to agree benchmark, long-term annual prices with producers. China and India shaved off considerable margins from producers, and succeeded in getting freight charges included into the annual price agreements. Now that fertiliser demand is picking up again, and economic recovery and investor confidence have returned to emerging markets, pricing-power has swung back more in favour of producers. And there is a concomitant change in the nature of fertiliser contract pricing, a shift away from the former model (annual contracts) and more to quarterly contracts, which more closely reflect spot prices – which are, given the low point of the economic cycle, quite strong.

Regional changes in fertiliser consumption 2008-2013

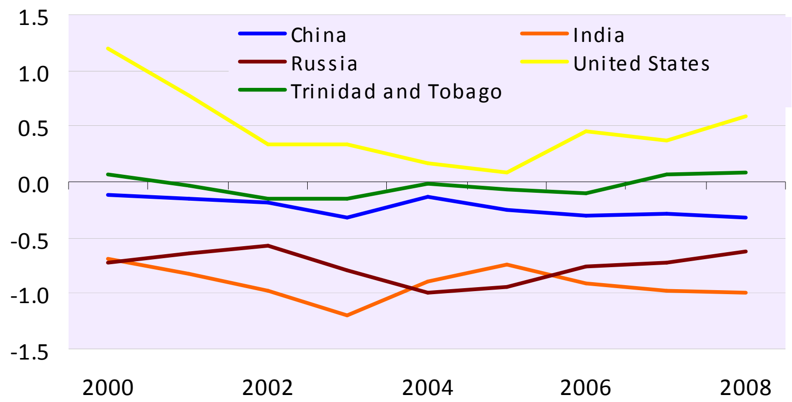


Source: VM Group from FAO

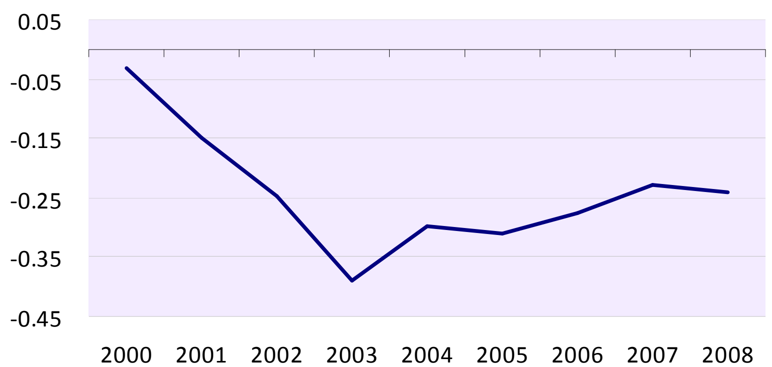
Future risk

The charts below show the evolution of political stability for the leading fertiliser producing countries, disaggregated by type of nutrient – **nitrogen**, **phosphate**, **potassium** and **sulphur**. We measure political stability based on the World Bank's worldwide governance indicators: zero is the average political stability worldwide; below zero means a country is more unstable than average; above zero means it is more stable than average. Weighting the political stability by each producer country's share of output (and including all producers, not just the top five) shows the following:

Political stability in the top five nitrogen producers



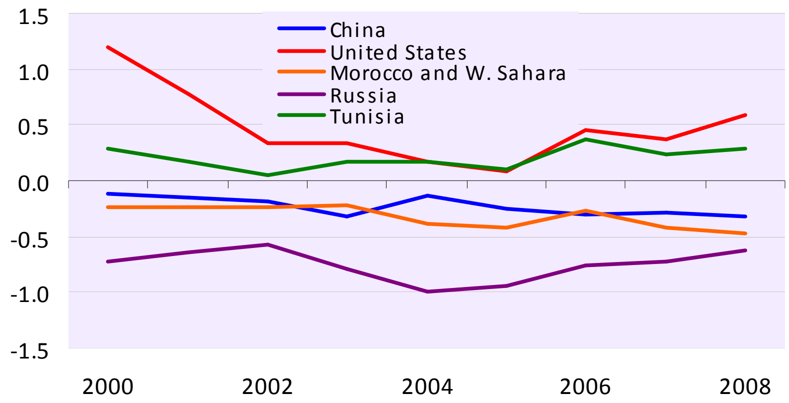
Political stability worldwide weighted by share of global nitrogen production



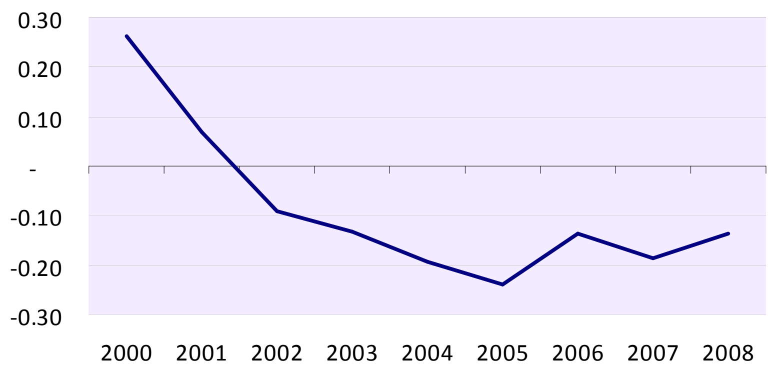
Source: VM Group

Nitrogen fertiliser production is carried out in countries that are less stable than the worldwide average, although stability weighted by production has been improving since 2003.

Political stability in the top five phosphate producers



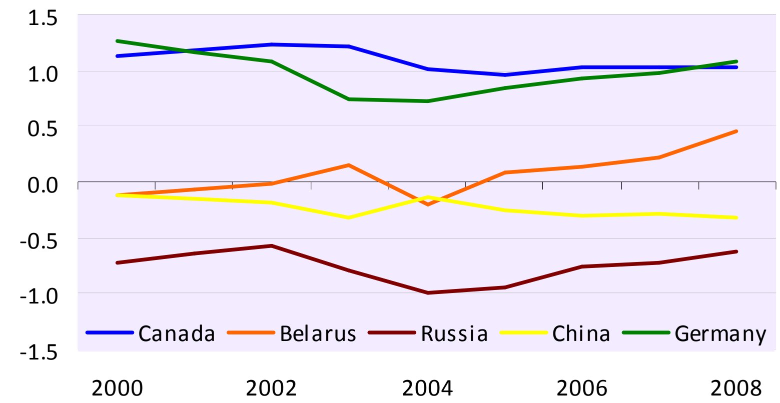
Political stability worldwide weighted by share of global phosphate production



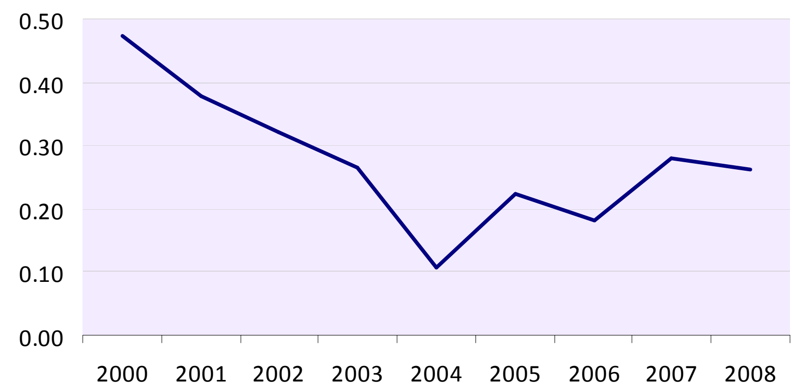
Source: VM Group

Phosphate fertiliser production is carried out in countries that are relatively stable. The countries involved in its production were declining in stability, but have improved since 2005.

Political stability in the top five potash producers



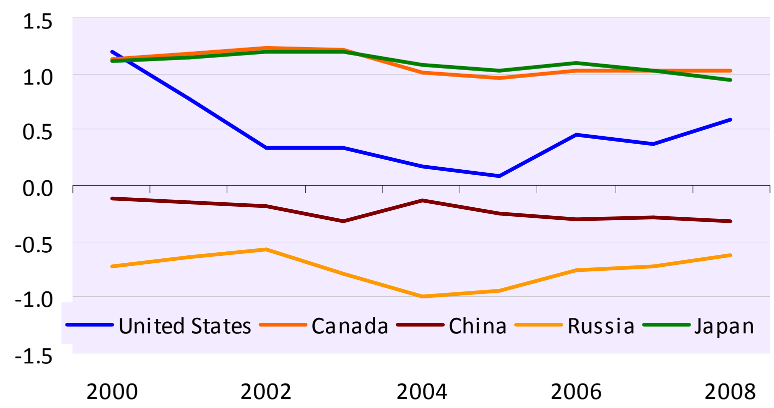
Political stability worldwide weighted by share of global potash production



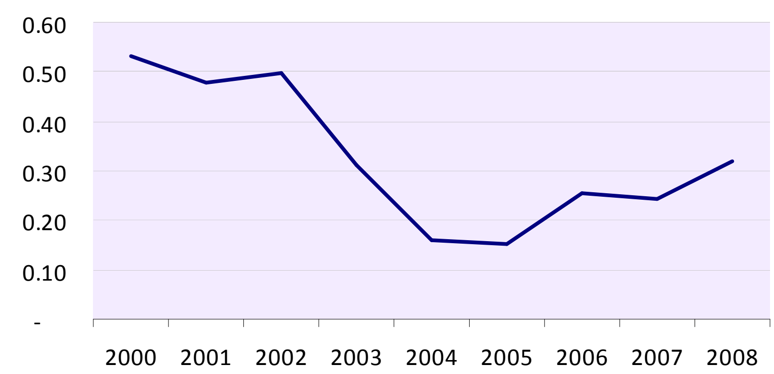
Source: VM Group

Potash fertiliser production is carried out in countries that are stable, and although this dipped during mid-2004, this has since then been recovering.

Political stability in the top five sulphur producers



Political stability worldwide weighted by share of global sulphur production



Source: VM Group

Sulphur fertiliser production is carried out, on average, in countries that are stable and this has been relatively constant for the past decade.

Production and prices

Production

There are four main sources of mineral fertiliser: nitrogen, phosphorus, potassium and sulphur, also referred to by the elemental symbols of (or a combination of) the first three – N, P and K. They occur naturally in soil, but are depleted over time. There are no substitutes, although manure and glauconite (greensand) have low potassium content and can be substitutes. Sulphur use in fertilisers is primarily in the production of phosphorous and nitrogen fertilisers. While there are no absolute substitutes for sulphur, some acids are usable in certain applications.

Nitrogen is drawn from the air and combined with natural gas to produce ammonia, which then forms the basis of several fertilisers including urea, ammonium nitrate and ammonium sulphate. Nitrogen assists plants to build protein and is an integral component of soil structure. China dominates nitrogen fertiliser production, at 44 Mt in 2009 (35%) of global totals.[2] India follows at 11.1 Mt (9%), Russia at 10.4 Mt (8%), the US at 7.7 Mt (6%) and Trinidad and Tobago at 5.1 Mt (4%). The key input factor for nitrogen fertiliser production (and price) is the availability of natural gas.

Phosphorous is mined out of phosphate rock deposits and then treated to make phosphoric acid which is the basis for phosphatic fertilisers including diammonium phosphate (DAP), monoammonium phosphate (MAP) and triple superphosphate. Phosphorous assists seed germination, photosynthesis and the efficient use of water by plants. It also helps crops to resist disease. The largest producer of phosphate fertiliser is China at 55 Mt in 2009 with 39% of market share, followed by the US at 27.2 Mt (18%), Morocco and Western Sahara at 24 Mt (16%) and Russia at 9 Mt (6%).

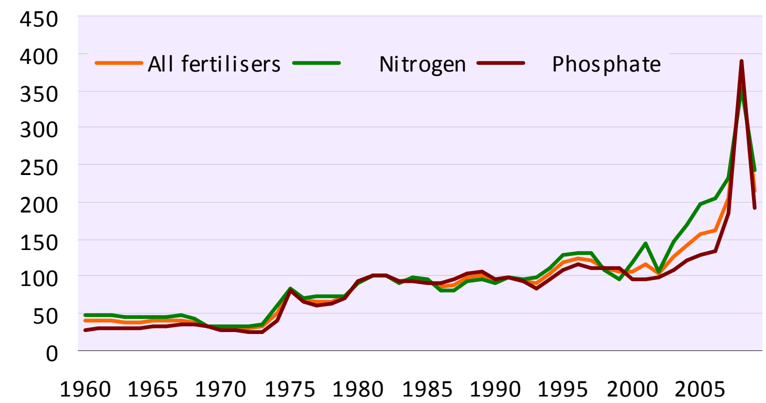
Potassium is mined from evaporated oceans, lakes and subsurface brines to produce potash, which is the basis for potassium nitrate, potassium chloride, muriate of potash and potassium-magnesium sulphate as well as other compounds including saltpetre. Potassium improves water use and regulates photosynthetic rates in plants; it also helps crops to resist pests and weeds. Canada dominates world potash production, at 6.5 Mt in 2009 – 27% of global supply. It is followed by Belarus at 3.9 Mt (15%) and Russia at 3.6 Mt (14%).

Sulphur is mined or retrieved from petroleum and natural gas refining. It is then either used directly as a plant nutrient in its elemental form or converted into sulphuric acid, a key material for processing phosphate fertilisers. Forms of sulphur fertiliser include sulphur, sulphur-bentonite mixes, ammonium sulphate, potassium sulphate, or superphosphates. Sulphur deficiencies can limit yields by preventing the maturity of fruit, retarding growth and affecting nutritional qualities. The US is the world's largest sulphur producer at 9.8 Mt (14% of global supply), followed by Canada at 9.3 Mt (also 14%), China at 8.5 Mt (12%) and Russia at 7.2 Mt (11%). Japan, Saudi Arabia and Kazakhstan each produce about 3 Mt or 5% of global supply.

[2] All fertiliser production data from the US Geological Survey 2009 estimates.

Prices

Fertiliser price index, 1982=100



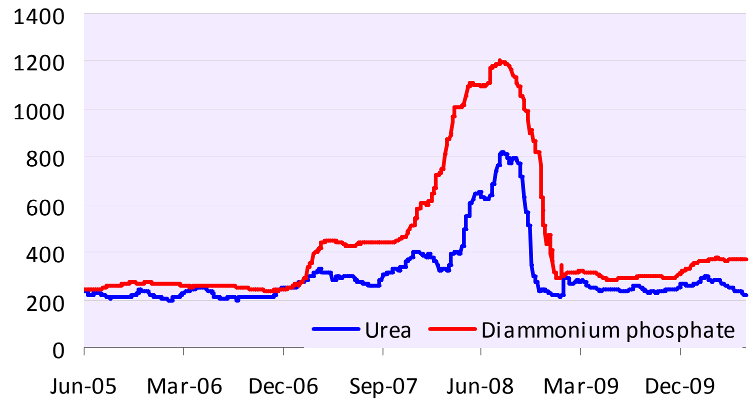
Source: VM Group, FAO

Fertiliser markets collapsed along with all other commodities in late 2008. Until that point, fertiliser supply was playing constant catch-up with rising demand, forcing prices to record levels – potash for example rose from $150/t to over $1,000/t in 2008. In the past year, however, financial constraints have led farmers to drastically reduce consumption, resulting in a 16% reduction in fertiliser volume traded in 2009 versus 2008.

Yet average prices for fertiliser have not collapsed all the way back to levels seen before 2005, and certainly not to those of the preceding decades. In other words we have entered an era of much higher base-points for all fertiliser prices, driven not by a massive onrush of speculative investment but by solid supply-demand fundamentals. Sales of fertilisers generally have already recovered strongly since mid-2009 and may shortly reach the heights of 2008 levels within the next five years, given the sharply upwards trend of global food demand.

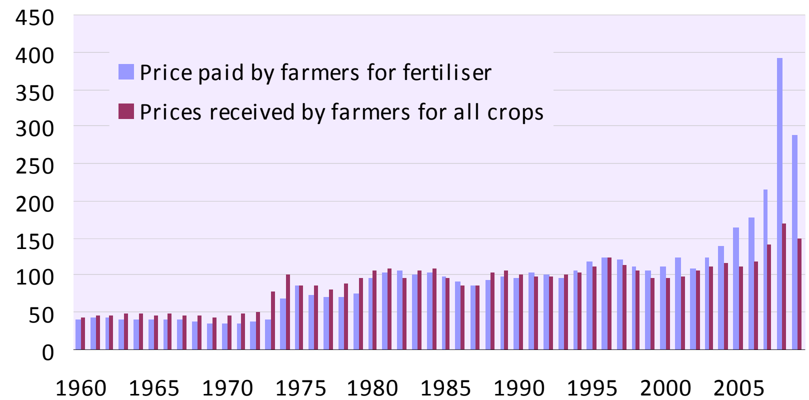
Potash is today trading at around $350/t, $200/t above where it started in the run-up to the commodity spike of August 2008. Urea hit highs of nearly $820/t in August 2008 and is now trading at $220/t. Diammonium phosphate reached close to $1,200/t in August 2008 and is $370/t right now. In comparison, in January 2005, which could reasonably be taken as a pre-commodity boom marker, potash traded at $245/t, urea at $180/t and diammonium phosphate at $232/t. Of course, variations in demand for different types of fertiliser drive some of these price movements. Farmers are less likely to cut back on nitrogen based fertilisers than others, because of the immediate and severe impact this has on crops.

Phosphate and urea prices, $/t



Source: VM Group

US prices paid for fertiliser and received for all crops index, monthly price/price in 1990-1992=100



Source: VM Group, US Department of Agriculture

In the US, fertiliser prices rose sharply between 2002-mid 2008. Crop prices – calculated as an average of all crop price indexes – also rose over that period, but not at the same rate as fertiliser. That prices soared in the US from 2002-2008 and continue to be high is due to factors shared with the rest of the world, and compounded by declining domestic US production of fertiliser, the high dependence of US farmers on imports (and competition in global trade) and the weak dollar – all of which made fertiliser relatively more expensive therefore to US farmers.

Price negotiations

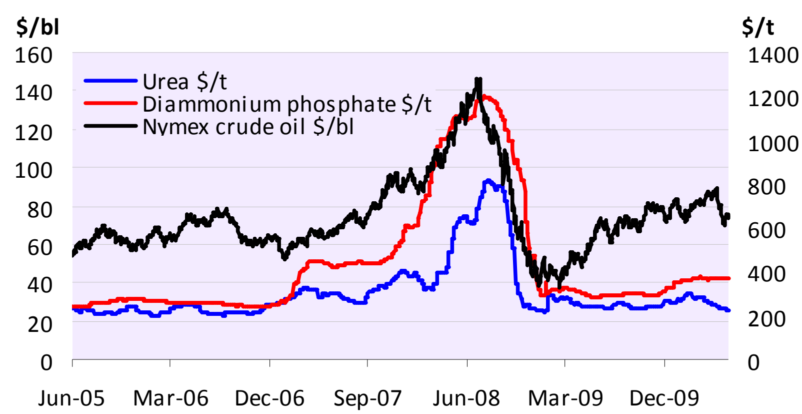
A key feature of fertiliser pricing has been the agreeing of prices on long-term contracts, typically for a year. This annual price contract fixing between major exporters and importers has been mutually attractive during previous eras, when price volatility was low, as it guaranteed a fixed price for importers and cash-flow certainty for exporters. But since the 2008 price spike this arrangement has been under stress, with exporters obviously aware that locking themselves into long-term fixed prices makes no commercial sense. Importers too have become cautious about locking themselves into long-term contracts – enhanced price volatility cuts both ways and, unlike many other commodities, hedging future price risk in fertilisers is difficult in the absence of a clear international futures' benchmark price.

We see developing a greater tendency of price setting to be for much shorter periods, on a quarterly rather than annual basis. There are parallels here with what has happened in iron ore, where the trend since 1945 has been for big exporters and importers to meet annually and strike a fixed price agreement for the year ahead. Iron ore prices have been just as volatile as fertiliser and the annual contract in iron ore has virtually disappeared. We see the demise of annual contracts in fertilisers as inevitable, especially as some big players in the iron ore world (particularly BHP Billiton and Vale) have started dipping their toes into fertiliser production – and are likely to bring the financial models deployed in iron ore to this new world of fertilisers.

Relationships with other commodities

Fertilisers' complex relationships with other commodities mean that price, demand and supply are governed by a range of diverse variables. Crude oil, natural gas, biofuels and the full range of food price movements all exercise their own specific influences.

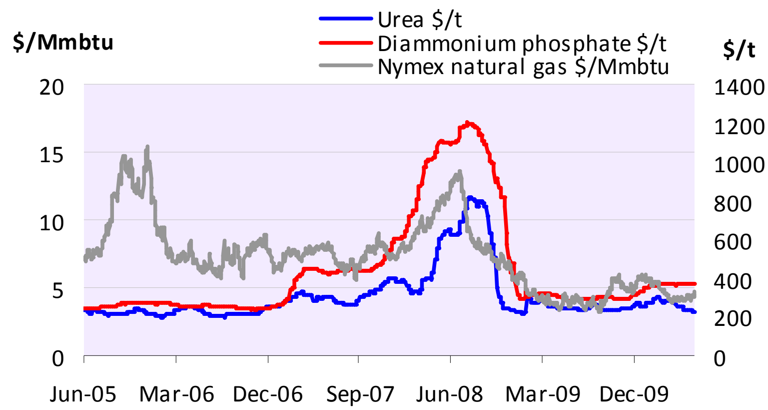
Phosphate and urea prices v. crude oil price



Source: VM Group

Arguably, nitrogen is most closely intertwined with a single other commodity, natural gas. Soaring natural gas prices until mid-2008 and exploding demand for fertiliser led to a shift in nitrogen production to countries and regions where natural gas is cheap and plentiful. Plans for the development of new nitrogen plants have been announced in the past couple of years in Algeria, China, Libya, Peru, Qatar and Uzbekistan – all natural gas producers. In 2009, natural gas prices declined until Q4, largely as a consequence of a collapse in industrial activity, helping to offset the costs of producing nitrogen during a particularly weak demand cycle; this resulted in a decline of just 1.5% in the consumption of nitrogen fertilisers during the recession, compared to a fall in demand of 10% for phosphates and 20% for potash.

Phosphate and urea prices v. natural gas price



Source: VM Group

We are living through a paradigm shift away from relatively abundant and cheap food. From 2005, food prices increased steadily until the recession, and, despite a slight lull over 2009-2010, we expect them to continue to do so. This is because even though grain production has increased significantly – with large crops of corn, soybean and wheat all expected in 2010-2011 – these bumper harvests are largely due to favourable weather conditions rather than any major scaling up of yields. Biofuel mandates are strengthening in many countries. In the US, the Environmental Protection Agency estimates that corn ethanol consumption will rise from 12bn gallons today to 15bn gallons by 2015. We face a global grain surplus this and possibly next season – but in the longer-term the rise in population, higher consumer spending on more expensive food (particularly meat), scarce arable land and diminishing supplies of accessible water for irrigation, will put increasing pressure on food supply. One answer to getting more out of the land will be found by applying more fertiliser. Fertiliser demand will rise in absolute terms, as the world tries to feed more people on shrinking resources.

Demand

Following consistent and fairly steady demand growth from 2003, demand for fertiliser plummeted in 2008, as prices were fast rising. The International Fertilizer Industry Association (IFA) considers that aggregate consumption in 2009[3] fell by 6.7% compared to 2008 figures, with very sharp reductions for potassium fertilisers (down 19.8%) and phosphates (10.5%), and a slight reduction for nitrogen (1.5%). The recession definitely hurt the industry, but did not completely choke demand – farmers generally opted to be much more thrifty in their application of fertiliser. Forecasts from the IFA for 2010 indicate a small decline for potash (down 4.5%), a slight increase in phosphate (up 3%) and a full return for nitrogen demand (up 1.6%), compared to 2009.

Most of this returning demand is coming from Asia, North America and West Asia, while demand recovery remains subdued in Oceania and Latin America. Together, East and South Asia are expected to consume around 55% of global fertiliser totals in the coming three years.

Regional demand trends

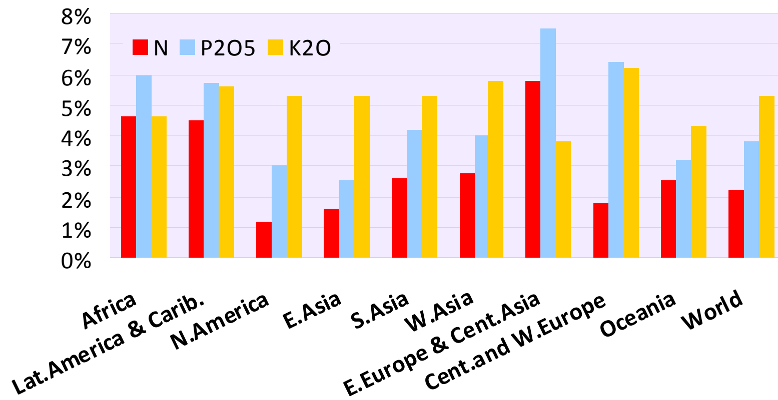
Long-term forecasts on fertiliser demand are rare, but the FAO attempts to construct likely future demand in its 2009 report *World Fertilizer Trends and Outlook to 2013,* which supports the short-term trends identified by the IFA and others in the industry.

The greatest demand growth for fertiliser comes from **East** and **South Asia**. Together, they make up more than 55% of the FAO's forecast of nutrients to be consumed globally by 2013. Long-term strong demand growth is expected for both phosphate and potassium fertilisers in the region, while demand for nitrogen fertiliser will increase more slowly, as China and the rest of East Asia approaches mature rather than emerging market status. China has a particularly serious problem with soil depletion, and although it appears to have resolved that in terms of nitrogen and phosphates, research[4] has shown that potassium deficits remain high nationwide. As a result, China needs to steadily increase the application of potash in order to achieve ideal crop production levels.

China's rising demand for fertiliser is today generated less by foods for direct human consumption, more from its massive livestock feed requirements. Even though China's population growth will start to level off, raised incomes and the already existing imbalance between people (20% of the world's population) and arable land (7% of global arable land) will make increasing crop yields a critical priority.

[3] For countries that compile fertiliser statistics in seasons, calculated on 2008-2009 figures
[4] "Soil nutrient audits for China to estimate nutrient balances and output/input relationships", William F. Scheldreck, Keith J. Syers, John Lingard, *Journal of Agriculture, ecosystems and & environment*, Vol 94, 2003

Regional trends in fertiliser consumption by nutrient, % increase 2007-2013



Source: VM Group from FAO

A recent nine-year study[5] of cereals and legumes (the bulk of the food we consume) concludes that there is a worrying phosphorous deficiency in arable soils worldwide, and especially in **Asia.** It says: "Asia consumes significantly more mineral P fertiliser in proportion to crop production than any other region – a potential environmental, economic and social problem."

In **South Asia**, Indian government subsidies have been used to support farmers and pacify the rural poor since the 1960s – but the unintended consequences have been enormous. The government bill for subsidising the fertiliser industry reached $25bn in 2008, from $4bn in 2004. This policy has skewed the type of fertiliser used (the subsidies made nitrogen based fertilisers cheaper, especially urea, which farmers over-utilised, ignoring potash and phosphates) and therefore distorted soil balances. Indian farmers will need to apply twice as much potash as today to reach needed crop yield levels. Attempts to slash subsidies and introduce some coherence into the process almost brought the current Indian government down. It appears to have survived though, and the new policy encourages farmers to use a better mix of nutrients, although the old urea-biased subsidies still remain for now, somewhat stabilising supply and price fears. It is clear that the full impact of the subsidy changes in 2010 will alter India's future demand for fertilisers as well as the balance of demand across the nutrient complex, although it is not yet possible to estimate to what degree.

Latin America is also expected to register strong fertiliser demand growth over the next five years, particularly for phosphates and potash. While not at the rate of Asia, and with economic recovery only really taking root this year, Brazil and Argentina will be the main engines for demand growth on the continent.

North American interest will continue to be driven by potash and phosphate, and by the vigorously growing US biofuel industry. North America's nitrogen imports will also increase in the longer term.

Eastern and **Central European** cereal and grain cultivation for export is picking up and will result in more fertiliser demand, especially from Russia in the short to medium-term. If Ukraine can recover from its macro-economic difficulties, it should also become a strong agricultural exporter.

In the **EU**, the 27 member states are subject to declining agricultural subsidies and support as well as tightening environmental standards – all of which will impact mineral fertiliser, although it is not yet clear what the aggregate effect of this will be.

[5] "A review of the phosphorus content of dry cereal and legume crops of the world" John Lott et al, *International Journal of Agricultural Resources, Governance and Ecology,* Vol. 8, 2010

In **Africa**, fertiliser demand is mostly a function of price. The cost of chemical fertilisers is generally beyond the average smallholder farmer. As a result, African farmers use an average of 8 kg of fertiliser per hectare per year, against a worldwide average of 90 kg per hectare. In the main this is because so much of sub-Saharan Africa is landlocked and freight costs drive up the price of all products transported from the coast. But African farmers also pay between two and six times the global price for fertiliser because of a combination of other factors including taxes, tariffs, and, because up to 80% of them are smallholders (under 2 hectares per farm), they lack the sort of negotiating clout that larger farms or farmers' associations could use to reduce prices. In 2006, to try and deal with this problem, African heads of state met at the Abuja Fertiliser Summit and pledged to boost average fertiliser use to 50 kg per hectare per year on the continent. Further, a number of African governments signed the Maputo declaration in 2003, which pledged to increase the proportion of government spending on the agricultural sector up from the current 4% average to 10%. Policies focusing on scaling up agricultural production in Africa are being backed up by offers of technical support from specialist non-profit organisations such as the Alliance for a Green Revolution in Africa, and funding from regional institutions such as the African Development Bank.

Fertiliser demand in **West Asia** in the long-term is expected to plateau, due to growing water constraints on crop production in the region. Drought in **Oceania** has been devastating for crops there, and had a consequent impact on fertiliser requirements. However, weather conditions permitting, strong demand is expected to return for fertiliser by 2013 – potentially to match 2007-2008 levels.

Demographics

The main drivers of food demand growth are population and income. The continuing increase in the global population is placing greater pressure on existing food stocks and requires the production of ever-greater quantities of food. The UN and FAO estimate that the extra 3bn people expected by 2050 will require a 40% increase in food production by 2030 and 70% by 2050, from average 2005-2007 levels. Further, the FAO, perhaps optimistically, forecasts that 90% of this crop production increase will come from improved yields and cropping intensities – with only 10% from land expansion. If this increase in yields is to be achieved it will clearly rely on the greater use of fertilisers.

Per capita food consumption (kcal per capita per day)

	1964-66	1974-76	1984-1986	1997-99	2015	2030
World average	**2,358**	**2,435**	**2,655**	**2,803**	**2,940**	**3,050**
Developing Countries	2,054	2,152	2,450	2,681	2,850	2,980
Near East and North Africa	2,290	2,591	2,953	3,006	3,090	3,170
Sub-Saharan Africa	2,058	2,079	2,057	2,195	2,360	2,540
Latin America and the Caribbean	2,393	2,546	2,689	2,824	2,980	3,140
East Asia	1,957	2,105	2,559	2,921	3,060	3,190
South Asia	2,017	1,986	2,205	2,403	2,700	2,900
Industrialised countries	2,947	3,065	3,206	3,380	3,440	3,500
Central and Eastern Europe	3,222	3,385	3,379	2,906	3,060	3,180

Source: VM Group from FAO

Calorie consumption levels on a global average basis have been steadily growing over the past 30 years, and will continue to do so. But within this overall average there are pockets of very much slower growth. Sub-Saharan Africa has barely improved its calorific intake in 40 years, but is expected to begin to do so in the next decade. East Asia and the Middle East have shown the most dramatic increases in per capita calorie intake. There have been global structural shifts in nutrition as well, with a move away from consuming tubers and roots, and towards more livestock products and vegetable oils. Emerging markets such as Brazil and China are also shifting from consuming cereals in favour of greater volumes of animal protein. These shifts have increased demand for animal feed – and fertiliser.

The global population is also urbanising at a rapid rate – the UN estimates that 70% of the world will live in urban areas by 2050, compared to 50% right now. A higher urban global population inevitably means fewer people relying on subsistence agriculture as their source of food, and fewer farmers will remain to grow ever-increasing quantities of food. All these factors are converging to create a growing demand for food and animal feed, which has a knock-on effect on the demand for fertilisers.

Biofuel developments

The huge surge in production of biofuels, itself prompted by anxieties over energy security and high fossil fuel prices has, over the past decade, transformed agriculture and sometimes the fate of entire countries, such as Brazil. The biofuels' bonanza has triggered a switch for certain crops from being consumed almost entirely as food to being used in greater proportions as biofuel feedstocks. Biofuels can be made from any cellulose plant – the process is chemically quite simple and requires first the extraction of the sugar content of the plant, which can then be converted to ethanol for fuel that can be either blended into gasoline or used by itself to power an engine. In the US, where mandated levels of ethanol blended into gasoline are gradually being raised, the preferred crop for ethanol production is corn. In Brazil, fuel ethanol is produced from sugarcane. These so-called 'first generation' biofuel feedstocks naturally require good levels of fertiliser application although corn absorbs less nitrogen than soybeans or wheat. Corn has shallower roots, and can only absorb surface applications of fertilisers. Corn requires high doses of fertiliser, has a high degree of fertiliser run off and can only absorb fertiliser for 60 days a year during its developmental period.

Today, the production of corn ethanol in the US consumes some 30% of the entire US corn harvest. Even with changes to the mandates to accommodate the expected role of advanced biofuels, corn-based ethanol is still expected to contribute about 42% or 15bn gallons of the US 2022 biofuel mandate – which in theory will total 36bn gallons. The rest, 58% or 21bn gallons, will supposedly come from 'second-generation' biofuels, which will not be derived from crops that can be consumed as human or animal food.

Whatever type of feedstock is used, more biofuel production means less land is available for food production. The International Energy Agency estimates that, if global biofuel use increases by 50% in the next 10 years, this would displace 21m hectares of food crops. Food demand would simultaneously be rising quite fast – so to fend off food shortages and/or much higher food prices it will be necessary to squeeze ever-greater food supplies from a shrinking global pool of arable land. This spells to us a protracted period in which fertiliser use will intensify dramatically.

Technology and innovation

Fertiliser use and application rates vary across the world. Some of this is down to prices and affordability , but it's not just about cost. More intelligent use of fertilisers by farmers can result in improved crop yields without simply applying ever-bigger volumes of fertiliser. A better trained and more technologically savvy farmer, who can access new techniques of crop development, will need to use less fertiliser to achieve the same crop yield than his less sophisticated neighbour, who simply piles on the nutrients without too much consideration. The development of a better educated global farmer populace could pose its own demand-side risks to fertiliser demand in the years ahead.

In the US, for example, corn production rose by 74% during 1980-2005, largely due to improvements to the method of fertiliser applications. These include placing fertilisers nearer to plant roots, or timing applications more appropriately to soil and weather conditions. Other advances have the potential to change both the productivity farming and, therefore, fertiliser demand. “No-till farming” was a technique developed in the aftermath of the 1973 oil crisis, when farmers needed to reduce their use of diesel and stopped ploughing their fields. A modern take on this method is now proving extremely successful at conserving nutrients and preventing soil erosion. Today, 100m hectares of crops globally rely on no-till farming, otherwise known as manual weeding. To prevent weeds from growing or spreading, weak herbicide sprays are used. This allows top soil retention, while the lack of ploughing helps to keep the soil structure firmer which in turn prevents the rain washing away nutrients, and keeps moisture in the ground longer. Costs are reduced, as inputs costs such as diesel are cut and capital equipment like ploughs are replaced less frequently.

Crop rotations, which switch out a cash crop for a planting season with some other nutrient friendly crop, are also proving to be a successful low cost intervention to help reduce soil erosion and nutrient depletion. Training on fertiliser use and scaling-up farming techniques – especially in countries such as China, where self-sufficiency in food production is considered part of the national security agenda – are also on the rise. China has dispatched 100,000 specialists to teach 160m farmers how to use fertilisers more efficiently, and to demonstrate the benefits of soil testing for nutrients. In the Sahel region of West Africa, which is prone to famine, a technique known as ‘microdosing’ – where small amounts of fertiliser are applied with the seed at planting – has proved an and effective way to raise yields.

Technological advances are helping farmers think more creatively about how they apply fertilisers – and also how much they apply. One such advance is the use of the relatively cheap “urea deep placement” system – briquettes of urea are placed beneath the soil, rather than as granules on top of it; these briquettes release fertiliser into the soil more slowly, and their sub-soil position reduces the amount of nutrient run-off during rainfall. On the other hand these briquettes are highly labour intensive, requiring manual placement, which makes them only really useful for smallholders. The International Fertilizer Development Center, a non-profit agency that helped develop the briquette technology, says that in Bangladesh their use has resulted in 40% reduction of urea, with a 20% increase in rice yields across 1.7m hectares of farm land. Eventually, the government of Bangladesh hopes to support their use across more than 12m hectares of land.

Other technologies are more expensive and probably more suited to industrial farming. GPS based mapping techniques have been utilised for “precision farming” or site specific techniques. This allows farmers to map the variations in soil composition over their land, and make decisions on fertiliser application on that basis. It reduces input costs from fuel, herbicides and fertilisers where they are not needed.

Public policy and international aid

Regionally focused initiatives concerned with poverty eradication and food security are also turning their attention to agricultural yields. The Alliance for a Green Revolution in Africa is a non-profit organisation that supports a range of programmes aimed at boosting yields and getting the post-subsistence agricultural produce of smallholder farmers in Africa to market. These steps include introducing hundreds of new varieties of staple crops, revitalising depleted soil through inter-cropping and microdosing, combining organic and mineral fertilisers and implementing water management and conservation techniques. But they also focus on the R & D and retail aspects, by adapting training and education to the specific circumstances of African smallholders. Perhaps the most crucial innovation however, is developing agro-dealerships – or small-scale farm retailers – to convey seeds, inputs, farm services and information to farmers in rural heartlands.

Other organisations target the value chain for staple and cash crops. These include improving access to premium markets through training farmers on quality, safety and sanitary standards. Research is helping to breed varieties that are more drought and disease resistant, as well as crops that are bio-fortified, or genetically modified to increase their nutritional content. Partnerships are key to all of these strategies, while structuring demand (for example through World Food Programme school feeding programmes) and supply so that farmers have more reliable markets and incomes is vital.

Elsewhere, targeted government subsidies – that give small farmers help with fertilisers combined with better seeds – have also led to dramatic results. In Malawi, government financial support for seeds and fertilisers led to a doubling of maize yields in 2005-2006, and a tripling of yields by 2007 – from 0.8/t per acre to 2.2/t per acre. There has also been a serious and concentrated effort by donors and international financial institutions to plug the hole in financing for agricultural development in the poorest countries. An initiative by the US, Canada, Spain and Japan has set up a $900bn trust fund for agriculture, managed by the World Bank and to be used over three years. The money will be spent on country-led and designed initiatives, specific to their own particular agricultural context and directed to raising production and efficiency and developing local markets. These new efforts will undoubtedly drive fertiliser demand in these (yet to be named) countries in the medium to long-term.

Supply

Potash production (000t)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Canada	9,200	8,200	8,200	8,500	9,150	10,700	8,360	11,000	10,500	6,500
Belarus	3,800	3,700	3,800	4,000	4,300	4,500	4,605	5,400	4,970	3,850
Russia	3,600	4,300	4,400	4,600	5,000	5,000	5,720	6,300	6,730	3,600
China	250	385	450	450	550	600	600	700	2,750	2,750
Germany	3,400	3,550	3,450	3,600	3,500	3,800	3,620	3,700	3,280	2,300
Israel	1,750	1,774	1,930	2,050	2,060	2,100	2,200	2,000	2,300	2,000
Jordan	1,100	1,178	1,200	1,200	1,230	1,200	1,036	1,100	1,220	1,100
United States	1,300	1,200	1,200	1,100	1,300	1,200	1,100	1,200	1,100	840
Chile	22	390	350	420	360	370	450	450	559	600
Brazil	350	352	352	380	340	400	405	410	471	500
Spain	450	525	407	470	500	500	437	450	435	400
United Kingdom	650	500	540	610	600	600	480	450	427	400
World	**25,300**	**27,400**	**27,000**	**27,400**	**28,400**	**31,000**	**29,100**	**33,000**	**35,000**	**25,000**

Phosphate production (000t)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
China	19,400	20,000	23,000	24,000	25,500	30,400	30,700	45,400	50,700	55,000
United States	38,600	34,200	36,100	33,300	35,800	36,300	30,100	29,700	30,200	27,200
Morocco and Western Sahara	21,600	22,000	23,000	24,000	26,700	25,200	27,000	27,000	25,000	24,000
Russia	11,100	10,500	10,700	11,000	11,000	11,000	11,000	11,000	10,400	9,000
Tunisia	8,340	8,100	7,750	7,700	8,050	8,000	8,000	7,800	8,000	7,000
Brazil	4,900	5,000	4,850	4,960	5,400	6,100	5,800	6,000	6,200	6,000
Jordan	5,510	5,500	7,180	7,200	6,220	6,230	5,870	5,540	6,270	6,000
Israel	4,110	4,000	3,500	4,000	2,950	2,900	2,950	3,100	3,090	3,000
Syria	2,170	2,100	2,400	2,400	2,880	3,500	3,850	3,700	3,220	3,000
Australia	1,800	1,890	2,025	2,200	2,010	2,050	2,300	2,200	2,800	2,500
World	**133,000**	**128,000**	**135,000**	**138,000**	**141,000**	**147,000**	**142,000**	**156,000**	**161,000**	**158,000**

Nitrogen production (000t)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
China	28,000	29,000	30,000	30,200	34,800	34,000	39,000	39,500	44,000	44,000
India	10,100	9,000	9,220	9,710	10,700	9,500	10,900	9,200	11,100	11,100
Russia	8,740	8,700	8,700	9,100	9,800	9,800	10,500	11,000	10,400	10,400
United States	12,300	9,730	9,500	8,770	8,850	8,700	8,180	8,300	7,850	7,700
Trinidad and Tobago	2,690	3,000	3,000	3,570	3,880	4,200	5,190	5,200	5,130	5,150
Canada	4,130	3,450	3,300	3,650	4,110	3,900	4,000	3,700	4,780	4,500
Indonesia	4,000	3,400	4,150	4,250	4,120	4,400	4,300	4,400	4,500	4,600
Ukraine	3,300	3,600	3,700	3,900	3,900	3,800	4,200	4,200	4,000	3,000
Germany	2,470	2,600	2,520	2,800	2,740	2,800	2,300	2,200	2,820	2,800
Saudi Arabia	1,740	1,400	1,400	1,740	1,730	1,900	2,000	2,600	2,600	2,600
Pakistan	1,880	1,900	2,000	2,360	2,360	2,100	2,200	2,200	2,300	2,300
Poland	1,860	1,900	1,900	1,910	1,980	2,000	2,100	2,100	2,000	2,000
Netherlands	2,540	2,000	1,980	1,750	1,970	1,800	1,800	1,750	1,800	1,800
Egypt	1,510	1,850	1,950	1,790	1,680	1,700	1,800	2,500	1,750	3,000
World	**109,000**	**105,000**	**107,000**	**109,000**	**117,000**	**115,000**	**124,000**	**131,000**	**136,000**	**133,000**

Sulphur production (000t)

	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
United States	10,300	9,250	9,270	9,600	10,100	9,460	9,060	9,090	9,450	9,800
Canada	9,900	9,360	9,400	9,030	8,890	8,973	9,047	8,967	9,280	9,300
China	5,200	5,380	1,300	6,090	6,630	7,710	8,020	8,460	8,610	8,500
Russia	5,900	6,250	5,500	6,600	6,920	6,950	7,000	7,050	7,170	7,200
Japan	3,500	3,370	1,100	3,310	3,150	3,260	3,330	3,200	3,270	3,300
Saudi Arabia	2,400	2,350	1,300	2,400	2,230	2,300	2,800	3,100	3,160	3,200
Kazakhstan	1,500	1,700	940	1,930	1,980	2,030	2,000	2,600	2,800	3,000
Germany	1,110	1,240	1,000	2,360	2,150	2,520	2,290	2,300	2,310	2,400
UAE	1,120	1,490	1,500	1,900	1,930	1,950	1,950	1,950	1,950	1,950
South Korea	490	1,270	1,300	1,300	1,680	1,690	1,690	1,690	1,850	1,900
Mexico	1,310	1,450	1,800	1,610	1,820	1,717	1,774	1,770	1,740	1,750
Chile	9,900	1,160	1,300	1,300	1,510	1,660	1,000	1,573	1,570	1,600
Iran	1,350	1,500	1,000	1,360	1,460	1,460	1,465	1,570	1,570	1,570
France	850	1,100	1,500	1,000	961	945	945	1,306	1,310	1,300
India	1,240	941	940	1,020	1,070	1,130	1,170	1,152	1,170	1,200
Poland	1,700	1,420	1,200	1,180	1,180	1,220	1,240	1,324	1,280	1,200
Australia	689	720	959	923	925	1,010	941	950	938	940
Italy	693	743	800	684	688	685	650	740	740	740
Kuwait	675	524	600	714	682	700	650	700	700	700
Finland	730	543	540	706	702	720	615	615	615	615
Spain	685	622	600	706	634	616	651	601	601	600
Netherlands	512	510	500	527	547	535	530	530	530	530
World	**57,200**	**57,300**	**58,000**	**61,800**	**64,100**	**66,000**	**65,700**	**66,000**	**69,600**	**70,300**

Source: VM Group, USGS

Note: World totals have been rounded up

Production and reserves

The International Plant Nutrition Institute, a well respected agronomic research institute, estimates that economically mined reserve supplies of all the fertilisers are sufficient in the long-term. A few decades out, however, there may be concerns over **nitrogen** – but only because of the natural gas required to process it, not because of any shortage of the element itself. After nitrogen, **phosphate** rock is probably most vulnerable, but there are still about 100 years of known reserves, at 2008 rates of production of 170 Mt annually. **Potash** is even more encouraging, with reserves stretching to 235 years. **Sulphur** reserves and resources of sulphur are largely tied to the processing of hydrocarbons. As crude oil and natural gas will continue to be processed in the long-term, supplies should be adequate for the long haul. The United States Geological Survey (USGS) says that world sulphur resources – whether in deposits or as a by-product of natural gas, petroleum, tar sands and metal sulphides – total 5bn tonnes. A further 600bn tonnes of sulphur could be recovered from coal, oil shale and shale deposits, when lower cost technologies become available.

However, as we note throughout this report, the abundance of the raw materials to make fertiliser will not necessarily count for much in price terms. Prices will continue to be governed by the variables associated with the cost of inputs such as natural gas, crude oil, freight and others and increasing food demand.

Struggle for supply control

There is no surer testimony to the probability of there being a general trend of rising fertiliser demand (and hence prices) than the fact that the normally moribund world of fertiliser equities has seen some very big takeover struggles in the past couple of years, together with the entry into fertiliser production of some giants of the mining world.

Partly this has been driven by a much greater awareness of the investment world of the possibility of capital gains in fertiliser companies. The spectacular rise in fertiliser prices to mid-2008 sparked an interest among not just commodity investors but also those looking for undervalued equity plays. The fact that fertiliser prices have, despite the worst Western world recession in 60 years, not collapsed back to pre-recession levels has alerted investors to one of the commodity world's more certain long-term growth stories – food, and how to get more of it onto the world's tables. Coming out of the recession, fertiliser producers have been showing some very strong performances. Potash Corporation of Saskatchewan, the world's largest fertiliser company, posted record sales volumes and revenues in Q1 2010, reflecting higher demand for potash specifically and better margins for nitrogen and phosphorous. Potash Corporation's CEO, Bill Doyle, considers that very strong supply-demand fundamentals underlie his company's results. In his view, "strong farmer returns, a depleted distributor pipeline and the agronomic need to replace soil nutrients have kick-started a potash rebound from 2009 lows."

On top of this, fertiliser producers are currently engaged in what is likely to be a lengthy shakeout of old practices (the decline of the annual price contract is indicative of this), and an industry-wide consolidation. There are relatively high barriers to entry in the world of fertiliser production, so it's natural that existing producers are keen to gobble up smaller fry rather than dive into expensive new projects. But there have also been this year two notable big plays by companies that have hitherto not been associated with fertilisers. BHP Billiton in January exercised its rights to become sole owner of the Jansen potash project in Saskatchewan, Canada. Describing the project as the "next long-life, low-cost expandable basin play for BHP Billiton," the company said that Jansen has 3.37bn tonnes of potash-bearing material, which is expected to produce 8 Mt/year of potash by 2015. With an initial investment in the project of $323m, BHP Billiton now has exploration rights over 14,000 square km in this potash-rich area and could invest around $3bn in the venture over the next ten years. The investment is a clear reflection that BHP Billiton sees this as a vital cash-generating enterprise, banking on strong emerging market demand for fertiliser. The investment is also a smart decision both in terms of diversifying from metals mining and exploiting its existing comparative advantages as a multinational with global logistics and export expertise.

This year too the Brazilian mining giant Vale acquired from Rio Tinto, Bunge and Mosaic various fertiliser projects, which effectively gives Vale dominance of Brazilian fertiliser production. Brazil's status as a global meat producer, world grain-basket, and biofuel giant is certain to grow in coming years – and Vale intends to ensure that its shareholders benefit from growth in all these areas, by gaining exposure to the fertiliser supply chain. Brazil is currently a net importer of fertiliser and Vale is positioned perfectly to take advantage of this growing national demand.

BHP Billiton is somewhat unusual in its move towards diversification, as companies across the fertiliser spectrum – from existing producers to mining companies that have newly acquired operations – have tended to invest in brown-field (existing capacity) ventures, and tend to shun the risks involved in developing new deposits. In part this is due to the barriers to entry problem, but it is also determined by price. To develop a potash green-field venture requires a price of around $600/t at the mine level. As of mid-2010, potash spot prices were a little more than half that. But, if demand continues in the long-term, as we expect it to, then the price point may well shift to the mark that justifies the development of green-field projects.

Other developments include actors in agriculturally driven emerging markets, like India, aiming to secure fertiliser resources at their source and over the long-term. In February, IFFCO, the Indian farmers fertiliser cooperative, bought a

20% stake in Canadian potash manufacturer GrowMax. The stake gives IFFCO a chance at diversification, but it also secures an offtake agreement that will have genuine supply and price stabilising consequences for potash consumers in India.

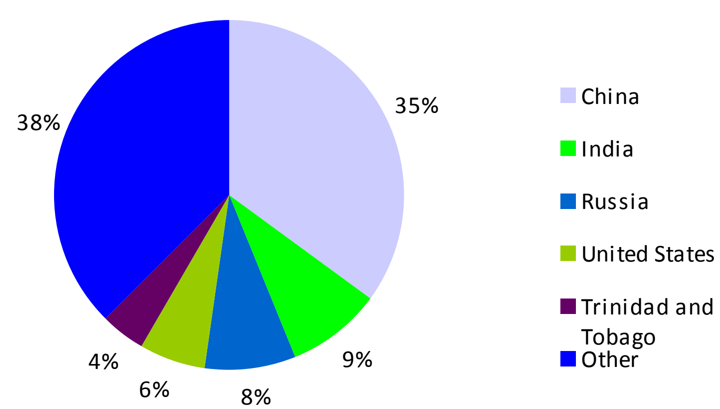
The consolidation trend is not confined to fertiliser producer companies alone, but also characterises fertiliser export companies. Belarusian Potash (BPC) and Canpotex (which is a marketing and distribution company wholly owned the major Saskatchewan potash producers) together account for 60% of global fertiliser exports. This massive share of the export market is effectively a choke point for supply. It has given these two fertiliser giants unparalleled pricing advantages in the past, and will certainly deliver more in the future.

Regional supply risks

Supply is not subject to any specific sovereign risk or country threats. However, there is some concern caused by the levels of concentration of some types of the fertiliser complex in certain regions or countries.

Nitrogen: The supply of nitrogen hinges on the dominance of China. Supply is likely to outstrip demand in 2010, but surpluses this year will fall from 2009's 10.5 Mt to about 8 Mt. Ammonia production rises were led by China – which contributed about 40% of the annual net increase in production in 2009. A combination of new plants and restored capacities is expected to increase global ammonia supply by 20% by 2013 compared to 2008. Urea production also grew in 2009, in response to strong demand from the US and India; together, these two countries account for 65% of global urea imports. More new urea capacity is expected in 2012, strengthening export positions in the Middle East, Africa and Latin America.

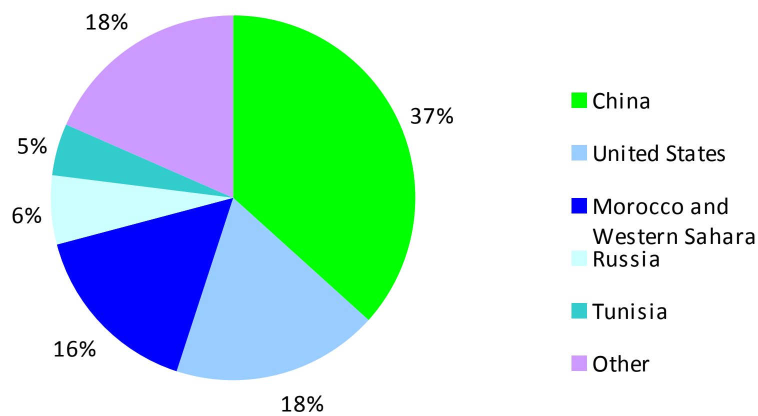
Share of world nitrogen production 2009/2010



Source: VM Group from USGS

Phosphates: Global phosphate production is growing steadily, and capacities are expected to be 30% higher by 2013 than 2008 levels. This is due to a raft of new mining projects or expansions. Many were in the pipeline before the financial crisis became a reality but were put on hold until more secure credit and demand could be established. These are now underway again. Half of all the new phosphate production projects are in China, the rest are in Africa, Latin America and the Middle East.

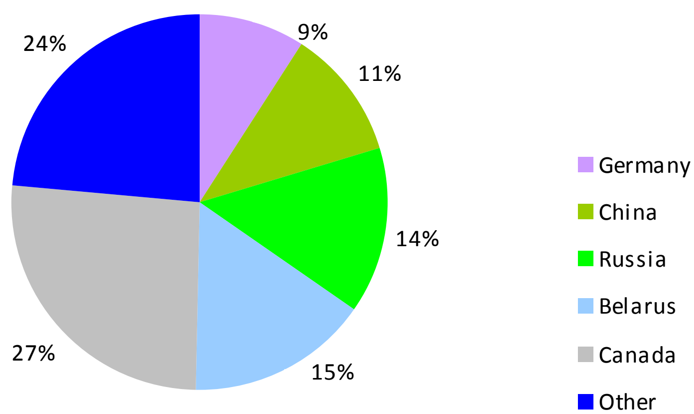
Share of world phosphate production 2009/2010



Source: VM Group from USGS

Potash: Potash production is almost entirely concentrated in North America, Belarus and Russia. Plans to expand capacity are at a lower rate than for other types of fertiliser, although additional projects are still expected to increase production by about 30%, mostly from Canada, Russia and China.

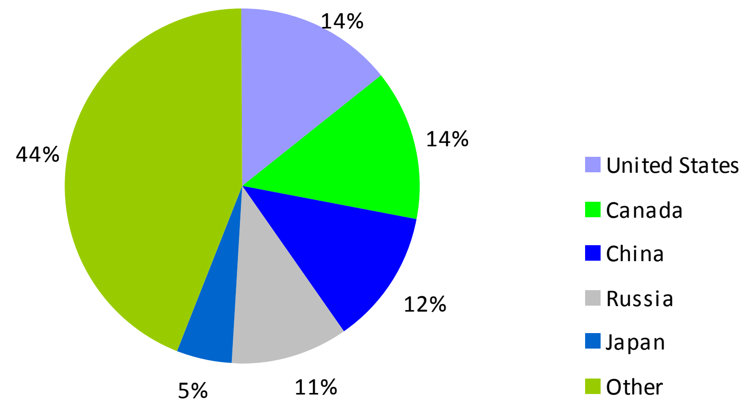
Share of world potash production 2009/2010



Source: VM Group from USGS

Sulphur: Despite the collapse in demand in 2009, production did not contract and in some regions expanded. In part this is because sulphur is produced as a by-product of refining hydrocarbons. This ensures that supplies – which are firm – will be constant, as sulphur production from natural gas decreases and refinery sulphur production increases over time.

Share of world sulphur production 2009/2010



Source: VM Group from USGS

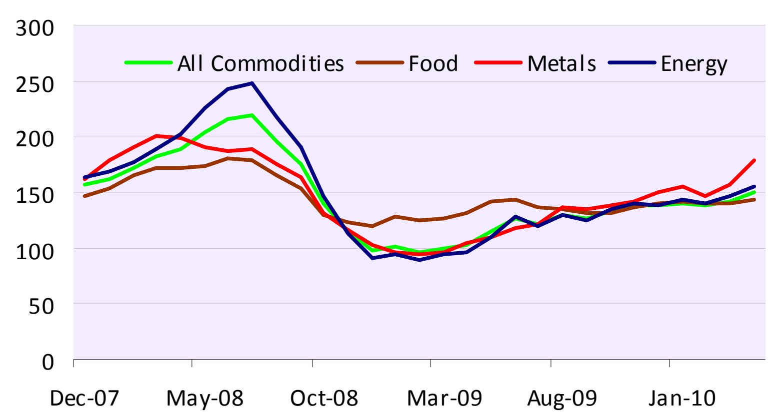
Commodity performance & economic risk

The housing and banking crisis that came to a head in September 2008 in the US quickly paralysed global capital markets. Although commodities also suffered, to some extent they decoupled from other markets, reaching their lows in February 2009, and picking up a fairly sustained momentum after that.

An IMF review in January 2010 found that the commodity recovery after the 2008 crash was significantly better than in comparable recessionary periods. In the eight months after the low of February 2009, the IMF commodity price index rose by 40% – against an average of 5% for the eight months following earlier crashes. And the 2009 price trend in commodities took place despite globally weak demand, spare capacity and high inventories.

Although still volatile, most commodity prices in H1 2009 remained higher, in some cases significantly so, than they were 12 months previously. Some agricommodities have fared badly in the past 12 months – wheat futures have dropped by some 25%, soybeans by almost 20%, and corn by almost 15%. But this reflects the fact that the 2009-2010 season is seeing a bumper global harvest for all these agricommodities, with the prospect being for global surpluses in all well into the 2011-2012 season, barring some extremely adverse weather conditions. Interestingly it's worth noting that on US commodity exchanges pork bellies, lean hogs and feeder cattle have all been excellent performers in the past 12 months, the futures prices up by 60%, 35% and 13% respectively – reflecting the rapid slashing of herds in the darkest days of the recession and consequently a perceived supply-demand tightness in physical markets now that the US recession is showing signs of coming to an end.

Commodity price index, 2007-2010



Source: VM Group, IMF commodity price index

The relative robustness of commodity prices generally, despite the recession, has much to do with China's continued thirst for commodities, and also to government stimulus packages around the world. But it also confirms two other trends. First, although commodity futures in H1 2010 have been almost entirely swayed by external forces (not least the strength/weakness of the dollar) they have nevertheless partially decoupled from other asset classes. Second, that the super-cycle of raw material driven-demand (spurred by the economic rise of China, and to a lesser extent India), has merely been delayed rather than destroyed.

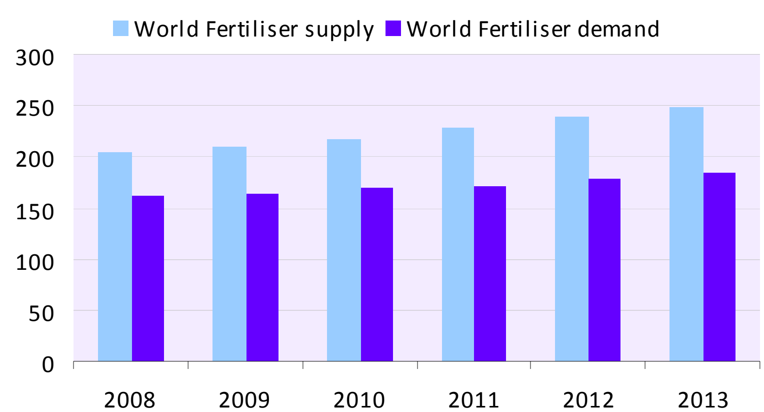
The risks right now are in the realm of sentiment and are driven by fears of overheating and bursting bubbles, particularly China's economy, and sovereign debt issues within the eurozone. Macroeconomic worries including high deficits and continued unemployment in mature economies are also problematic. Political risk issues are also riding high but reveal more about the jittery nature of the markets than a sustained and serious risk of new wars breaking out or any other possible threat to supply. In general, there has been a shift from a purely Asian-led period of economic growth to a more sustained global recovery – with every region (including Europe) likely to see some return to GDP growth in 2010. The IMF forecasts global average GDP growth at 4.2% in 2010 and at 4.3% in 2011.

Conclusion

Despite erratic markets, sovereign risks associated with the euro and other political and economic concerns, the state of the global economy is in recovery mode. The World Trade Organization reports that Q1 2010 global exports were up by 27% on the same period in 2009. There are weak regions, particularly Europe, but the US economy is slowly improving (although longer-term fiscal issues remain worrying) while Asia and the emerging markets have largely shrugged off the whole crisis.

For fertiliser, short-term surpluses are available but this does not guarantee weak prices. Demand from China and India is strong and growing, and policy support mechanisms – whether in the form of biofuels mandates or agricultural subsidies in North America and Europe – will continue to help drive fertiliser demand.

World fertiliser balance 2008-2013, Mt



Source: VM Group, FAO

The only true constraints to fertiliser production come from input costs – whether energy, labour or freight. These are currently not price restrictive but certainly could be if the commodity super-cycle reasserts itself vigorously. Farmers and the agricultural lobby will continue to push for government subsidies and – given the probability that food security issues are going to be as important as energy security issues in the next decade – their demands will be listened to by politicians everywhere. Fertilisers have emerged from the financial crisis on a higher price platform than in the pre-2008 era. Barring a global catastrophe, prices will be much higher a decade from now than today.

About VM Group

VM Group is a commodities research consultancy that covers not just conventional energy, but also renewable energy, carbon, base and precious metals, and agricommodities. The VM Group comprises a uniquely skilled team that is highly experienced in the analysis of the fundamentals of commodities and their geopolitical impact and contexts.

VM Group work excels in macro-economic analysis, the generation of supply and demand scenarios, costs analysis, derivative research and price forecasting. Confidentiality, experience and independence are key elements in this advisory capacity. We deliver excellence to those in need of external expertise, as well as those who wish to supplement their own in-house resources. Our extensive international contacts mean we are able to span the globe.

To see further how we can meet your research and consulting requirements, please email: info@vmgroup.co.uk

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