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Argus FMB Strategy Report: World Processed Phosphates Outlook to 2029

June 2015

Prepared for: OCP Group

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Executive Summary

Supply of P_2O_5

The following conclusions emerged from our analysis of phosphate fertilizer supply:

- The major contributor to new supply of P_2O_5 will be Morocco's OCP which will continue to progress its Jorf Phosphate Hub project in line with the established plan and timetable. The current phase of four new integrated DAP/MAP units with a capacity of 450,000 t/yr P_2O_5 each will be complete by the end of 2016, and the final phase of six more complexes will follow, one of which will supply a new granulation unit in Gabon under a joint venture arrangement. OCP will also invest in the development a new complex in Safi under the Safi Phosphate Hub programme (SPH), through the addition of further integrated fertilizer production which is expected to start operations in 2021. Additionally, we expect the Ma'aden Mosaic joint venture to be producing 1.5mn t/yr of P_2O_5 exportable products by 2018;
- On the other hand the long-term decline of P_2O_5 production in the developed countries of North America and Europe will continue, but at a slower pace, since many of the weaker units have already disappeared, with the recent closures of Missphos Pascagoula and Uralchem Voskresensk. Investment in the export countries of North Africa and the Middle East looks likely to be slowed down by continuing political instability in the region;
- The major uncertainty in the global market has been and will remain the Chinese industry, which over the course of this century has switched from being the world's largest importer of processed P_2O_5 to becoming a major exporter. The evidence of our research is that the build-up in production and export capability is reaching its peak. During the course of the next five-year plan (2016-20) we expect to see a plateau or gradual fall in both production and exports of P_2O_5 and of ammonium phosphates in particular.

Product Developments

Within the overall supply of P_2O_5, we expect to see some shifts in the pattern of products:

- Ammonium phosphates will continue to dominate the sector. We expect no surge of growth in any other product sector — for example, nitrophosphate or triple superphosphate — on a global scale;
- On a local level, we will of course see some non-ammonium phosphate investment, for example in superphosphates in Brazil, in single superphosphate in India and probably in other countries whose availability of rock is either too small and/or of too poor quality to justify phosphoric acid production;

- The industry is seeing the impact of changing demand patterns on the structure of the ammonium phosphate sector
  - The production of modified ammonium phosphates is likely to increase, especially where they have formed the backbone of a large blending sector, as modified ammonium phosphates offer a convenient means of introducing small quantities of secondary and micronutrients to a blend in a way that ensures that an acceptable distribution can be achieved;
  - A growing proportion of ammonium phosphate production will also be converted into multinutrient products granulation capacity at source, rather than sold for adaptation in the market;
  - This development will favour industry players with access to captive or low-cost nitrogen, potash and/or sulphur — for example, the Russian and Saudi industries. For producers whose main strength lies in P_2O_5, joint ventures with nitrogen producers may be the way forward.

Demand

Global demand for P_2O_5 is expected to grow at an average annual compound rate of around 1.6pc/yr over the next 15 years. The main growth will be seen in the developing world, in the expanding agricultural sectors of the former Soviet Union (FSU), particularly Russia, and also in Brazil where demand is driven by soybeans and the cultivation of nutrient-impoverished soils.

The development of products incorporating secondary and micronutrients is a response to a rapidly growing awareness in the market of the need for and benefits of balanced fertilization. We analyse in detail the requirement for micronutrients and their benefits in terms of greater efficiency in the utilization of all other nutrients and in crop, animal and human health in the Argus FMB Strategy Report *Micronutrients - The New Market Driver*.

Our research for this study suggests that:

- An awareness of the benefits of balanced fertilization is to be found in both developed and developing agriculture;

- If the base production of phosphate fertilizers does not include other nutrients, they will be added at the merchant level in blending, coating, compaction or co-granulation with the merchant taking the added value;

- As the price per unit of processed P_2O_5 rises, we are seeing an increase in demand for reactive phosphate rock and locally produced low-analysis phosphate fertilizers. Products such as low-grade single superphosphate may offer not only phosphate, sulphur and calcium, but may be used as a carrier for micronutrients.

Trade

We expect no major shifts in traded P_2O_5 patterns in the longer term. The main change will occur in the formulation of the product. China, Morocco, Russia and Saudi Arabia will continue to dominate P_2O_5 export sales. For the sector as a whole, we expect to see the following trends:

- The major export vehicle for P_2O_5 remains the ammonium phosphate industry. With the introduction of low-grade ammonium phosphates on the one hand and modified ammonium phosphates on the other, this market is beginning to fragment and is becoming more difficult to monitor. The distinction between ammonium phosphates and NPKs is being eroded, as they both move from their traditional arenas towards the developing market for multinutrient fertilizers. This does not mean that a substantial market for traditional diammonium phosphate and monoammonium phosphate will disappear, but the market may increasingly perceive them as raw materials or intermediates in the production of end-fertilizers;
- Traded volumes of all other phosphate products — superphosphates, merchant acid and chemically combined NPKs — are either static or in decline;
- The major swing factors in the global ammonium phosphate trade will remain India's import appetite and China's export capabilities;
- There has been an increase in the volume of merchant rock sold for direct use, which reflects:
  - Growth of the oil palm sector in southeast Asia;
  - The availability of low-cost rock from Egypt and other smaller suppliers;
  - The need to reduce the cost of nutrients.

  Political instability in Egypt and conflict in Syria are limiting the development of this market, while expectations that the situation in these countries will eventually stabilize, combined with the low selling price of much of this rock, are discouraging investment in new export projects capable of producing a low-grade reactive rock.

Prices

- Diammonium phosphate can be taken as the benchmark and an analysis and forecast of prices for this product follows. But we note that with the development of modified ammonium phosphate products such as Mosaic's MicroEssentials and OCP's new multinutrient products, the use of diammonium phosphate as an over-arching phosphate price benchmark will wane by the next decade;
- The base view of this analysis is that there has been a long-term shift in diammonium phosphate production costs and pricing, associated with an

upward shift in sulphur and ammonia price fundamentals. Added to this is OCP's ability to exercise a degree of market control and earn an associated margin on its sales of diammonium phosphate and other phosphate products. This margin will fluctuate with general market conditions in the course of the normal cycle and the long-term market control margin on diammonium phosphate is assumed to be $180/t;

- The market control margin is assumed to come under more significant pressure in 2016-18, by which time OCP will have completed the first major tranche of capacity under the Jorf Phosphate Hub programme (JPH), adding around 4mn t/yr of ammonium phosphates to the current capacity. Additional pressure will come in 2017-18 with the start-up of the Ma'aden/Mosaic/Sabic joint venture phosphates export project. However, even in periods of market weakness, average annual fob diammonium phosphate prices are not expected to fall below $460/t for more than a couple of months with an absolute floor of around $450/t, and are expected to mostly stay in the $460-500/t range on an annualised basis in 2015-19. The long-term trend forecast is for Moroccan diammonium phosphate prices to rise to around $574/t fob by 2029.

Section 1: Market Analysis and Outlook

Chapter 1: Phosphate Demand

The market for phosphate fertilizers is best considered as a whole, since there is substantial flexibility in how producers take raw materials, in their choice of end-product and in the way in which consumers purchase P_2O_5. In respect of supply, phosphate fertilizers producers may take:

- Phosphate rock if they are producing phosphoric acid, nitrophosphate, fused magnesium phosphate, single superphosphate or fertilizers containing unacidulated phosphate (as an input in NPK compaction and granulation units);
- Phosphoric acid if they are producing ammonium phosphate-based fertilizers or technical products;
- Ammonium phosphate or superphosphates, if they are compacting, blending or co-granulating compound fertilizers.

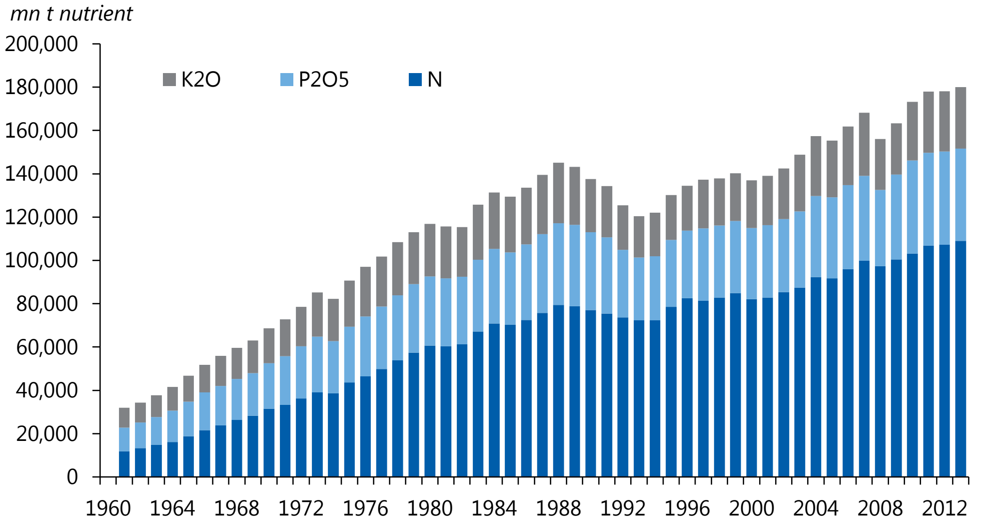
Some plants have the option to produce a combination of ammonium phosphates, triple superphosphates and NPKs. Wholesalers have the option to purchase NPKs or ammonium phosphates, which are then blended or sold as such. Farmers have the option to purchase fertilizers as straight (single nutrient) materials, which they may apply separately or mix to their specification prior to application. Alternatively, they can purchase ammonium phosphates and apply them directly or in combination with other products, or purchase ready-to-apply multinutrient fertilizers that have been chemically combined or blended. Phosphate rock is also purchased for direct application. This usage has grown in recent years, driven by the high price of final products, although it still only accounts for a small proportion of global P_2O_5 consumption.

The main demand drivers influencing the fertilizer sector can be summarised as:

- Population growth;
- Changing dietary patterns;
- The bio-fuel sector.

The first and second drove growth in fertilizer usage from the 1960s to the late-1990s — with a major interlude following the collapse of the Soviet Union in 1989. And all three have combined to produce significant consumption growth since then.

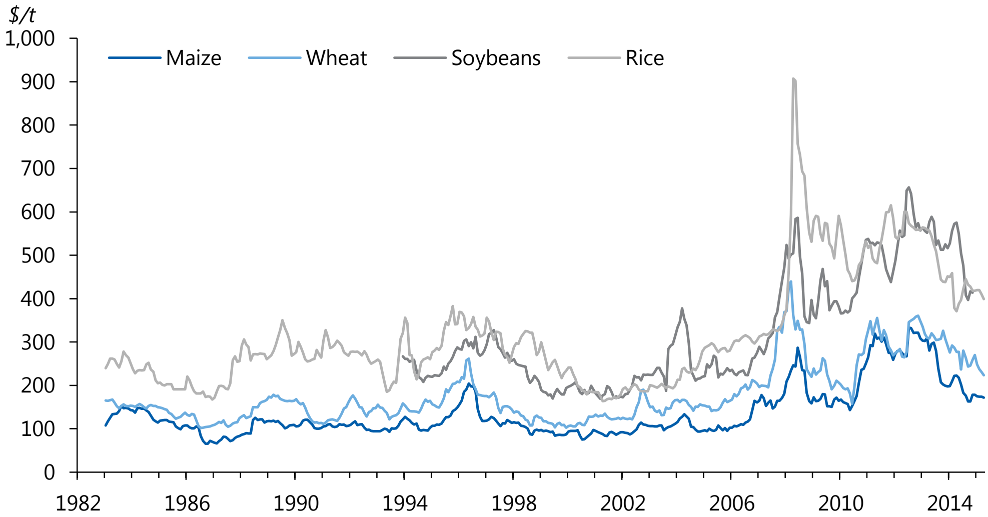
Figure 1-1: World Fertilizer Consumption 1961-2013



— IFA/Argus FMB, Argus FMB projection for 2013

Prices for the major crops have all fallen since 2013, although, in nominal terms, most remain above the levels achieved prior to the commodity market boom of 2007-08.

Figure 1-2: Major Crop Export Prices

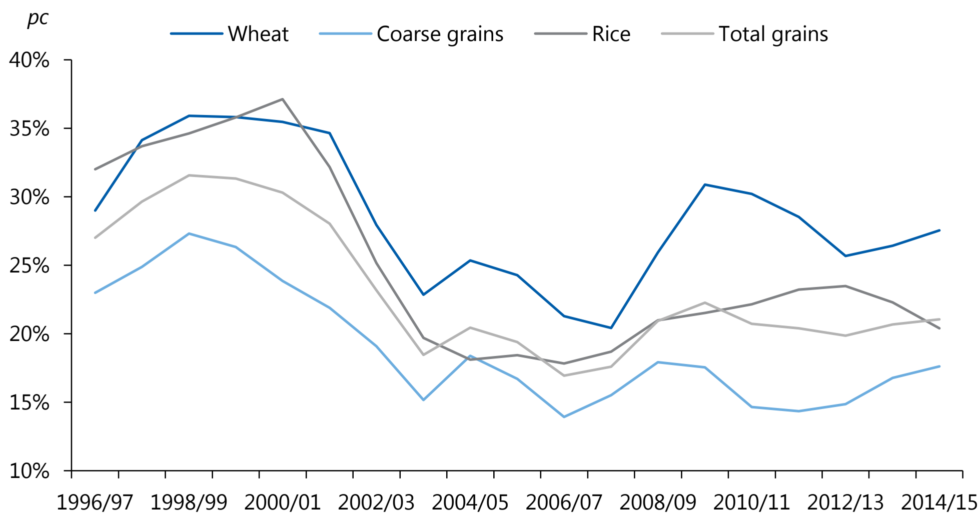


— FAO, World Bank

A series of good harvests in many key producing regions of the world in 2013 and 2014 has eased the stock situation for grains, and contributed to a decline in grain prices. At the same time, the US has reached the mandated limit of the usage of corn for ethanol production which had been supporting rising corn prices.

Despite a recent softening in the prices of major crops, there is unlikely to be further significant downward movement. There has been a structural break in agricultural commodity pricing and a return to the long-term decline in crop prices observed for two to three decades to the mid-2000s is looking unlikely. This is based on the assumption that the fundamentals of population and income growth are unlikely to change significantly. Growing urbanisation and inadequate water supplies represent significant constraints to expansion in agricultural production. Politically driven demand for biofuels is set to continue, even if the economic viability of these products is doubtful. And the success of the US shale oil and gas boom puts hydrocarbon alternatives into question. Added to this is an increasing desire around the world for food security, amid continued concerns that we could potentially face a global food crisis, as stocks remain relatively low.

Figure 1-3: World Grains Stock-to-Use Ratios

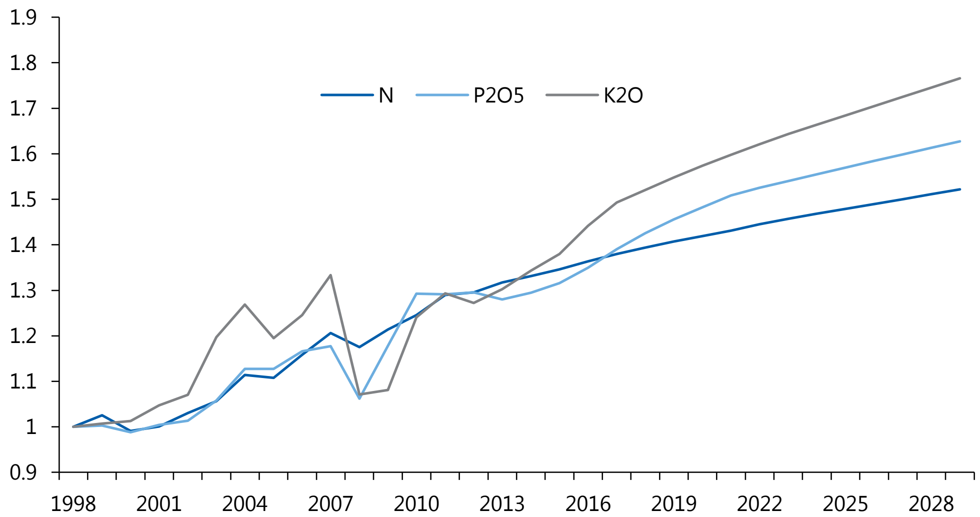


— *USDA, April 2015*

On the other hand, environmental pressures will see fertilizers used more efficiently, while technological developments will produce gains in food yields with a lower commensurate increase in fertilizer usage. Technological change slowed during the two to three decades before 2007, during a period of long-term food price decline. But a recent boom in prices, combined with changing perceptions of food security, has provided an incentive for new agricultural research. GM crops and other biotechnological advances, with their yield and input-saving advantages — such as introducing nitrogen-fixing DNA to crops that would not normally have this function — may be embraced worldwide. In the case of phosphates, scientists are working on the development of GM crops that use P more efficiently, but success has so far proved elusive, as work on more than one gene is required. And political, environmental and economic hurdles also remain.

In terms of the relative performance of the three nutrients, phosphate fertilizer consumption showed fairly robust growth in the 15-year period from 1998-2007. This is particularly the case from the early-2000s onwards — roughly matching nitrogen demand growth, although lagging the expansion in potash usage. But many countries and regions registered a downturn in phosphate and potash usage following the financial and economic crisis in 2008-09. Nutrients tend to remain in the soil, while nitrogen and sulphur are much more mobile, and farmers tend to reduce or omit applications of P_2O_5 and K_2O in periods of economic pressure. For the most part, phosphates have recovered from the global market crisis, and looking at overall growth in the three nutrients in the 15-year period to 2012-13, there has been a rough convergence with nitrogen and potash. By contrast, we expect to see a divergence in growth paths over the next 15-years to 2029, with potash the strongest performer, followed by phosphates and nitrogen.

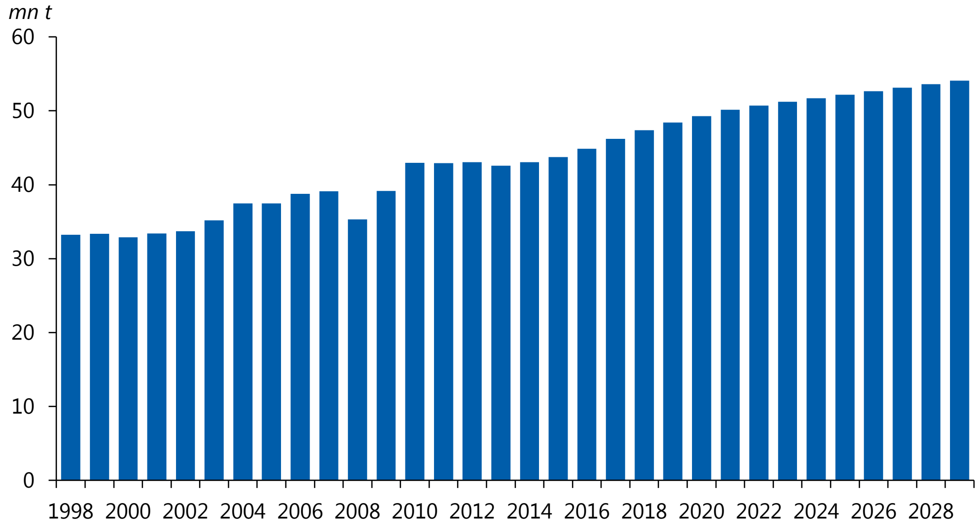
Figure 1-4: Index of World Fertilizer Consumption 1998-2029 (1998=1)



— Historical figures IFA/Argus FMB; Argus FMB projection for 2013-2029

Total phosphate fertilizer consumption is projected to rise from 42.9mn t P_2O_5 in 2014 to 54.1mn t P_2O_5 in 2029. This 11.2mn t P_2O_5 increase is 1.6mn t higher than the 9.6mn t increment seen in the previous 15 years. The forecast growth is equivalent to around 40mn t of rock.

Figure 1-5: World Phosphate Fertilizer Consumption 1998-2029



— IFA, Argus FMB

The following table examines the changing usage of phosphates by region over the last 15 years, and the expected changes in the next 15 years.

Table 1-1: Phosphate Fertilizer demand by region 1999-2029					mn t P_2O_5
	1999a	2014f	2029f	Change 2014-1999	Change 2029-14
World Total	**33.3**	**42.9**	**54.1**	**9.6**	**11.2**
West Europe	4.1	2.7	2.9	-1.4	0.3
East Europe/Central Asia	1.1	2.0	3.2	0.8	1.2
Africa	1.0	1.3	2.8	0.3	1.5
North America	4.6	4.3	4.9	-0.3	0.6
Latin America	3.3	6.6	8.8	3.3	2.2
Middle East	0.8	0.5	0.8	-0.3	0.3
South Asia	5.7	7.3	11.3	1.6	4.0
South East Asia	1.6	2.0	2.9	0.5	0.8
East Asia	9.7	15.0	15.0	5.3	0.0
Oceania	1.5	1.3	1.5	-0.2	0.2

— IFA /Argus FMB historical; Argus FMB forecast

We add the following comments on historical demand and the current forecast:

- Developed markets have seen a small decline in phosphates consumption for food crops, reflecting agricultural competitiveness and past over-application. In particular, there was substantial overuse of P_2O_5 in Europe over many years and significant soil reserves were accumulated. They are only slowly being eroded, but simultaneously, agriculture is under pressure from environmental lobbies. A ban on the burning of crop residues has meant that a significant part of the phosphate applied is re-cycled by ploughing in. Fears of nutrient run-off are already an important factor in determining application levels in Europe and increasingly in North America. These factors underpin the stagnation in these markets, even in 2000-07 when agricultural commodity markets boomed.

  On the plus side, the political pressure to increase biofuels production has seen some additional use, with the removal of set-aside in the case of the EU. Much of the land that was set aside is not of premium agricultural quality, and needs significant levels of nutrient inputs to ensure satisfactory yields. Nevertheless, the outlook for these countries is unexciting. From the viewpoint of trade, expectations of weak consumption growth should be seen against a background of plant closures within the EU. It is likely that the last big ammonium phosphate unit in northern Europe — Police, Poland, 900,000 t/yr plus NPK/DAP — will have to close for environmental reasons in the medium term as its ability to stack more gypsum is limited. The plant could extend its existing stacks by producing more NPK, or alternatively move to phosphoric acid as the phosphate input, and avoid further production of phosphogypsum entirely.

  A similar fate awaits a number of plants in eastern Europe, as the conditions for EU membership become binding. On the other hand, the cadmium debate in Europe could work to the advantage of products based on Russian phosphate rock and also Finnish and Norwegian NPKs;

- In the developing world, nitrogen is always the first nutrient to be applied in large volumes, as it shows the most immediate results. P_2O_5 tends to be the next nutrient to become the focus of attention, as improved yields from the use of nitrogen begin to flatten out. Overall, where an acceptable N:P ratio has been achieved for the cropping pattern and soil conditions — notably in many of the most important growth markets including Brazil, India and China — P_2O_5 consumption is expected to grow in line with nitrogen and agricultural production. China's move away from its 95pc self-sufficiency policy is likely to result in the country importing more agricultural products, particularly from South America and Africa, reducing the pace of Chinese fertilizer consumption growth compared with the recent past.

Table 1-2: NPK Ratios, 2012

	N	P	K
World Average	**1**	**0.38**	**0.26**
Brazil	1	1.26	1.41
Vietnam	1	0.52	0.34
India	1	0.40	0.12
Canada	1	0.33	0.14
China	1	0.35	0.17
United States	1	0.34	0.37
France	1	0.23	0.24
Pakistan	1	0.26	0.01
Indonesia	1	0.22	0.47

— IFA

The aim to achieve balanced fertilization has shifted the focus to potash, and is likely to progress to sulphur and other secondary nutrients and trace elements in the future:

- In **eastern Europe and central Asia** there are signs of growth. Countries such as Russia, Ukraine, Belarus and Poland have great scope for enhancing the productivity of their agricultural sectors. And in the case of Russia, Ukraine and some other CIS countries such as Turkmenistan and Uzbekistan, there is significant potential to expand the crop planted area. Russia and Ukraine have recently seen a rise in demand for all fertilizer nutrients as their agricultural sectors are gradually being reformed and local producers begin to focus more on developing their domestic market. But the political and economic situation in Ukraine is likely to lead to a reversal of the recent phosphate demand growth, at least in the short-term. Overall growth in phosphates usage in the eastern Europe and central Asian (EECA) region is projected at 1.2mn t P_2O_5 over the next 15 years. It is likely that a greater proportion of output will remain in the domestic market or within the region, and capacity expansions will be required if export levels are to be maintained. Such expansions take time to plan and implement and will depend on guaranteed access to phosphate rock, such as Acron's development of its Oleniy Ruchey mine, which was commissioned in 2013. Without guaranteed access to rock, some plants in the region, for example in Ukraine, could come under pressure, despite a buoyant market. As Russia converts more of its rock to processed phosphates, it is not hard to imagine non-integrated competitors being starved of raw materials, as experienced by Uralchem at its Voskresensk plant in 2014. All future expansion of Russian phosphate rock production is likely to be processed in situ rather than exported. The premium high-grade of the rock that is exported will probably make it unattractive for basic phosphoric acid-based fertilizer producers;

- Over the past 15-years, **Africa** has failed to register any significant rise in phosphate fertilizer consumption. But there is growing interest in the region, driven by the development of the agribusiness sector in countries such as Ethiopia and Sudan. And also by non-governmental organisations (NGOs) interested in developing infrastructure to promote the supply of raw materials to the sector, for example, the International Finance Corporation, World Bank and Bill Gates Foundation.

  Africa represents a major growth opportunity and one of the last frontiers for significant growth in phosphate fertilizer consumption. Most of this potential is based in east and west Africa, and we assume that it will be increasingly harnessed over the next 15 years. But this is dependent on a stable political environment. South Africa is already a mature market for nitrogen (170-180,000 t/yr P_2O_5) with little potential for further growth. Egypt is the largest north African consumer, but there is still scope for increasing the area under irrigation, and we expect to see a greater emphasis on both phosphate and potash fertilizers.

  In the case of east and west Africa, many countries have land available for bringing under permanent cultivation and existing agricultural land where yields can be much improved — including through multi-cropping. The fertilizer markets of both east and west Africa are seeing strong growth, albeit from a low base. The systemic problems hindering regional agricultural development — a lack of available foreign currency for purchasing fertilizers, poor infrastructure and limited or no access to credit for farmers — are showing signs of easing. And many governments are developing fertilizer subsidy programmes aimed at the small-holder sector. At the same time, the region's plantation sector has been boosted by (sometimes politically sensitive) investment by foreign agribusiness companies.

  The recent fertilizer growth seen in countries such as Ghana (mostly NPKs so far), Tanzania, Ethiopia and Kenya is a reflection of solid economic advances, and is unlikely to be derailed by anything other than political factors.

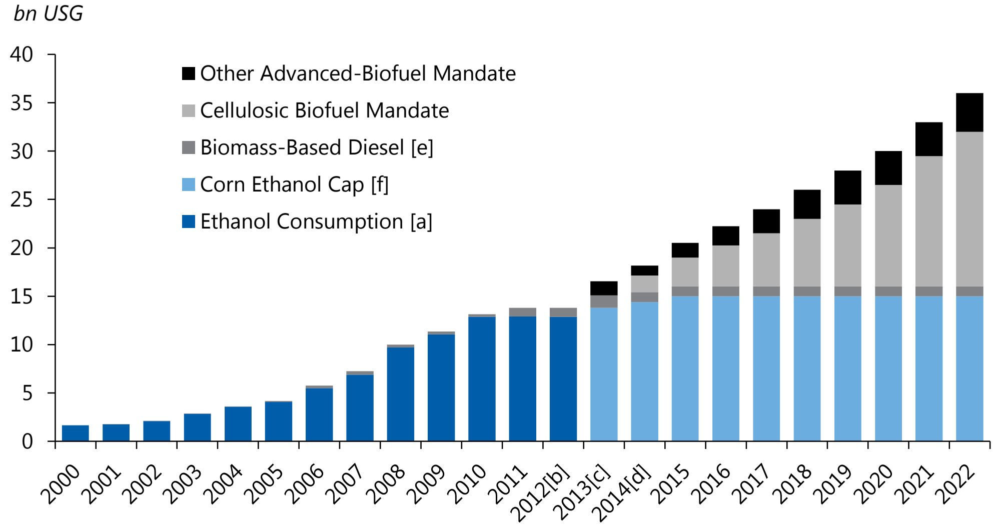
  In Nigeria, developing the agricultural sector has returned to the top of the agenda, after several decades of neglect and in the face of rising grain imports. Increasing fertilizer use is a key component of the Nigerian government's strategy to improve food security for its large and rapidly growing population by harnessing the country's rich agricultural resources. With the recent sharp decline in oil prices hitting Nigeria's foreign exchange earnings, the need for improvements in agriculture has increased further, but the means to achieve them through subsidies will be considerably diminished.

Growth in imports into east and west Africa may result in existing ports evolving into key hubs for fertilizer trade on the continent, with the development of transportation and distribution corridors inland. In east Africa, the hubs with the greatest potential are Djibouti, Beira (Mozambique), Mombasa (Kenya) and Dar-es-Salaam (Tanzania). Dictated by geography, the situation for west Africa is more fragmented, with a number of smaller ports handling fertilizers. Tema (Ghana), Dakar (Senegal), Abidjan (Ivory Coast) and Lagos (Nigeria) currently handle in excess of 100,000 t/yr of fertilizers.

In the short and medium term, countries in Sub-Saharan Africa that do experience demand growth are likely to focus first on nitrogen, although we are seeing greater volumes of ammonium phosphates going into east Africa and more NPK sales to west Africa over the last two to three years. Ethiopia is a good example, as it has traditionally consumed urea but has recently switched to importing NPS. Overall, we assume a 1.5mn t P_2O_5 increase in phosphates consumption in Africa over the next 15 years;

- Phosphate demand in **North America** has been in the 4.6mn-4.7mn t/yr P_2O_5 range in recent years, and we expect usage to show modest growth in the next 15 years (+600,000t P_2O_5). US phosphate fertilizer consumption decreased in 2014, on the back of lower crop prices. In the short-term, lower grain prices and in particular lower corn prices relative to soybeans, are encouraging a switch towards more areas planted with more phosphate-intensive soybeans. This reverses the trend seen in the last seven years when more land was planted with corn to supply the mandated requirement of ethanol for biofuels in the US. The country has now reached a peak in terms of this usage, and may even see a decline.

Figure 1-6: Past Renewable Fuels & Future Requirements of the Renewable Fuel Standard



— US Congressional Budget Office June 2014

[a] Primarily corn ethanol, but includes small quantities of sugarcane ethanol and other types of advanced biofuels either produced domestically or imported
[b] Renewable Fuels in 2012 roughly unchanged on 2011 levels, but fuel blenders and importers achieved compliance with RFS by submitting 'renewable identification numbers' (RINs) accumulated from exceeding obligations in previous years.
[c] For 2013, the EPA retroactively reduced the cellulosic biofuel requirement for that year to 6mn gallons and raised the mandate for biomass-based diesel to 1.28bn gallons. Actual figures yet to be available.
(d) Volumes required under EISA.
[e] Minimum requirement for biomass-based diesel of 1bn USG under EISA. EPA will set the actual requirement through future rulemaking.
[f] The cap on corn ethanol represents the maximum amount of such ethanol that can be used to meet the total requirement for renewable fuels under EISA.

- Under the Energy Independence Security Act (EISA), the 2007 Renewable Fuel Standard (RFS) set the mandatory volume of corn-based ethanol that refiners and other obligated parties had to blend with US gasoline at 13.8bn USG in 2013 rising to 14.4bn USG in 2014, and to a maximum level of 15bn USG in 2015. At the same time the non-corn/advanced biofuels requirement was due to rise from 2.75bn USG in 2013 to 3.75 in 2014 and 5.5bn USG in 2015, thereafter accounting for all of the 16.5bn growth in the total renewable fuels requirement to 36bn USG by 2022. The non-corn/advanced fuels include Brazilian sugar-based ethanol, soy-based biodiesel and fuels manufactured from solid biomass in technologically advanced plants, but most of the growth would come from cellulosic ethanol;

- However, as the Congressional Budget Office (CBO) report of June 2014 notes, the requirements of the EISA will be very hard to meet because of two main obstacles: the amount of ethanol that older vehicles can tolerate and the potential future supply of cellulosic biofuels;

- In the case of vehicle tolerance, currently most gasoline sold in the US is a blend of 10pc ethanol (E10) — the maximum concentration feasible to avoid corrosion damage to engines and fuel delivery systems in older vehicles, and the level most manufacturers are willing to warranty. The EISA requirement for growing usage of biofuels combined with a decline in gasoline usage, which is projected to continue, suggests that the average concentration would have to rise well above the so-called 10pc blend-wall, potentially increasing to 25pc by 2022. More ethanol could be accommodated in the fuel supply if flex-fuel vehicles (up to E85) bought larger volumes of such fuel. However, less than 2pc of filling stations in the US currently sell high-ethanol blends with little incentive to expand further under the current RPS, since the cost of encouraging additional sales of high-ethanol fuels falls on producers and consumers of gasoline and diesel;

- In response, the EPA released a draft biofuels mandate in October 2013, reducing volumes required across the various fuels and, finally, new mandated volumes were announced in June 2015, setting 2014 levels retrospectively to those levels already achieved and reducing 2015 and 2016 volumes. In the table below, we compare the original mandated volumes for 2016 with those set in June 2015.

Table 1-3: US EPA Renewable Fuel Standard – Mandated Volumes for 2016 *bn USG/yr*

	Policy Date	
	2007	**June 2015**
Total	**22.25**	**17.4**
Bio-ethanol	15.0	14.0
Advanced Biofuels	7.25	3.4
Of Which:		
Biomass-Based diesel	1.0	1.8
Cellulosic Biofuel	4.25	0.206
Other Advanced Biofuel	2.0	1.394

— EPA June 2014

- Reducing standards helps compliance in the short-run but reduces incentives for companies to invest in production capacity for cellulosic and other advanced biofuels and to expand the availability of high-ethanol blends, making future targets yet more difficult to meet. Not surprisingly, the EPA's revisions led to an outcry from biofuels groups while refiners and other blenders will certainly continue to lobby against the on-going uncertainty and, in some instances, call for the entire RPS to be scrapped.

- It is hard to second guess what shape future biofuels mandates will take, especially as the country continues to benefit from the rapid growth in oil and gas production from the shale revolution, even if this growth is tempered in the wake of the recent decline in international oil prices. Nevertheless, we expect some policies to encourage filling stations to sell high-ethanol blends on the one-hand and buyers with flex-fuel vehicles to buy these blends on the other hand, resulting in the 15bn USG bioethanol cap being reached as older vehicles are replaced with new vehicles;

– Overall, the policy seems likely to lead to some switching away from corn acreage to soybeans in the US midcontinent to supply new soydiesel facilities. This will have a negative impact on nitrogen but a roughly neutral effect on phosphate usage;

– The table below presents the latest USDA baseline forecasts for area planted to the major crops:

Table 1-4: US Planted Acreage to of Major Crops to 2024 *mn acres*

	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023	2024
Corn	95.4	90.9	88.0	90.0	90.0	90.0	89.5	89.5	89.0	89.0	89.0	89.0
Sorghum	8.1	7.2	7.5	7.5	7.4	7.3	7.3	7.2	7.2	7.1	7.1	7.0
Barley	3.5	3.0	3.5	3.3	3.2	3.0	3.0	3.0	3.0	3.0	3.0	3.0
Oats	3.0	2.7	3.0	2.8	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
Wheat	56.2	56.8	56.0	53.0	52.5	52.5	52.5	52.5	52.0	52.0	52.0	52.0
Rice	2.5	2.9	2.9	2.9	2.9	3.0	3.0	3.0	3.0	3.0	3.0	3.1
Upland cotton	10.2	10.8	9.8	9.8	9.8	9.9	9.9	10.0	10.1	10.2	10.3	10.4
Soybeans	76.8	84.2	84.0	79.0	78.0	78.0	78.5	78.5	79.0	79.0	79.0	79.0
Total	**255.7**	**258.5**	**254.7**	**248.3**	**246.3**	**246.2**	**246.2**	**246.2**	**245.8**	**245.8**	**245.9**	**246.0**

—USDA Agricultural Projections to 2024, February 2015

The sharp downward adjustment in nitrogen-intensive corn forecast for 2015 from 95.4 mn acres in 2013 to 88 mn acres is expected to be roughly maintained, with total acreage to corn stagnant at 89 mn ha. Wheat acreage is projected to fall from 56 mn acres in the short-term towards 52 mn acres in the medium-term, stabilising at this level to 2024. After a short boost to soybean acreage in 2014 and 2015 to around 84 mn acres, the total acreage is expected to adjust back to around 79 mn acres;

– In the longer-term, we expect that both the US and Canada will play a growing role in supplying the fast-growing populations of Asia with grains and meat, as food prices resume an upward trend. This will be the primary driver of phosphate usage in the region.

- **Latin America** will remain a focal point for demand growth in the foreseeable future. There is significant scope for expanding the agricultural land area and intensifying farming, particularly in Argentina and Brazil. Both of these countries are expected to increase their role in supplying the international market with food and oil crops in the coming 15 years. Given the importance of soybeans — a crop that saw tremendous growth in the first half of the 2000s, Brazil has a higher ratio of phosphate and potash to nitrogen, beyond that of a country with a less dominant single-crop sector. In particular, the Cerrado region is one which will see an increase in cultivation — especially for soybean production. As previously mentioned, the supply of bioethanol from sugarcane to the US market, being classified as an advanced biofuel, could provide a further significant impetus for an expansion in production of this crop in Brazil or other Latin American countries. We are projecting total Latin American growth of around 2.2mn t P_2O_5 in 2014-29, which equates to a requirement for around 8mn t of additional phosphate rock;

- Excluding China, **Asia** will remain the powerhouse of fertilizer demand growth. Population growth alone dictates this, and demand for food production will be coupled with growth in industrial demand for biofuels.

  India is expected to see the biggest absolute increase in phosphate fertilizer demand in the region during the next 15 years (+3.4mn t P_2O_5), assuming a reform of the fertilizer sector that will encourage a more balanced use of fertilizers through the deregulation of urea, which will ultimately increase the use of phosphates and potash. The Indian government announced a new urea policy for 2015-16 in May, which is again delaying the crucial move of lifting controls on urea prices to ensure a more balanced use of the three nutrients. The MRP for urea will be unchanged throughout the current fertilizer year, while the subsidy for DAP will continue at Rs12,350/t.

  Pakistan, Bangladesh and Indonesia will also drive demand upwards, as P_2O_5 consumption still lags behind nitrogen consumption in these countries and a period of catch-up is required if balanced fertilization is to be achieved (recent figures suggest Bangladesh is on such a new trajectory).

  China's agriculture ministry announced its yearly targets in May, as part of its plans to achieve zero growth in the consumption of fertilizers and pesticides and a fertilizer efficiency rate of 40pc by 2020. Under the plans, China aims to achieve less than 1pc growth in fertilizer consumption in 2015. It will target less than 0.8pc growth in 2016, less than 0.6pc in 2017, and less than 0.4pc in 2018. China is planning on reaching its zero growth target and an efficiency rate of 40pc by 2020. These targets are expected to be reached by increasing the use of more accurate fertilization methods and through the use of organic fertilizers — not chemically produced — which will be achieved through strengthening links between producers and farmers, and promoting new fertilizer technology, including the encouragement of mechanised fertilizer application. The ministry launched this campaign in order to reduce fertilizer demand and raise usage efficiency, following concerns about inefficient use and potential ecological damage.

  We are projecting total Asian growth of around 4.8mn t P_2O_5 in 2014-29, which equates to a requirement of over 17mn t of additional phosphate rock.

Chapter 2: Phosphate Rock and Phosphate Fertilizers

2.1. Phosphate Rock Changes and Developments

This section summarises changes and developments in the phosphate rock sector and their impact on the production and use of phosphate fertilizers. A detailed analysis of the phosphate rock market is available in the recently published *Argus FMB Strategy Report-World Phosphate Rock Outlook to 2029*.

A number of issues have arisen over the past few years that affect attitudes to phosphate fertilizers.

Peak Phosphate

The notion that phosphate reserves would be depleted, leaving the phosphate fertilizer industry facing closure, was not only an exaggeration but fundamentally incorrect. There are sufficient phosphate resources globally to support demand for centuries to come. The exponents of the "peak phosphate" thesis confused cheaply mined, high-quality and conveniently located reserves with total resources. The growing costs of mining, beneficiating and delivering rock of a grade and quality suitable for use in phosphate fertilizers have been reflected in the prices of fertilizers and intermediates since the early years of this century. The sector is not supply constrained, but it is cost and quality constrained.

Rock Production/Delivery Costs

The costs of extracting and processing rock have risen at many existing mines. And they are significantly higher at many of the greenfield projects where the cost of moving rock/product from new projects is also generally greater, as they tend not to be connected to export terminals. This has resulted in much higher landed prices for P_2O_5 at all stages in the chain — raw material, intermediate and finished product. The increased cost of P_2O_5 in whatever form is already causing a rethink about fertilization in many poorer countries, not just in the amount of P_2O_5 applied in periods of peak prices, but equally in the form in which P_2O_5 is used. Unacidulated and partially acidulated rock are being increasingly used and local deposits of phosphate, which may be small and/or of poor quality, are being examined for potential as a raw material for single superphosphate, or direct application.

Grade and Quality

The grade (P_2O_5 content) and quality (impurities) of the output from many of the projects that have been put forward is less suited to sale as merchant rock, even if expensively beneficiated. The trend towards vertical integration, driven by the recognised economic advantages of processing in situ, will be reinforced by quality issues. This will adversely affect mining projects relying on a period of merchant sales at an early stage to produce cash flow for later phases of development.

Environmental Issues

The long-standing trend of developed world plant closures, often resulting from problems with the disposal of phosphogypsum continues. The latest victims have been the Agrifos plant in Pasadena, Texas, US and the Fertiberia plants at Huelva in

Spain. The rate of attrition has slowed, as the number of surviving non-basic plants is reduced to a handful. This does not necessarily mean that fertilizer production halts with the closure of phosphoric acid manufacture. The Pasadena unit has switched to merchant sulphuric acid and, more recently large-scale ammonium sulphate production. The Fertiberia plants fed by Huelva acid switched to imported phosphoric acid but this proved uneconomic and diammonium phosphate production has been stopped.

Final Product Form

The majority of phosphates are applied to the soil in combination with other nutrients, mainly NP and NPK and to an extent PS, for example, single superphosphate. For many developing countries the green revolution saw an initial input of nitrogen, followed by phosphate when yields stagnated. During this period, which lasted from the 1960s to the turn of the century, urea and diammonium phosphate dominated market growth. Since the turn of the century, potash has become the limiting nutrient and has shown sharp growth in developing agricultural economies. Simultaneously, a host of secondary nutrients, most notably sulphur and magnesium but also calcium and micronutrients, particularly boron, zinc and manganese have been extracted from the soil to the point at which replenishment is required. These changes are having a significant effect on the structure of fertilizer usage in many parts of the world, and will increasingly impact fertilizer production and consumption patterns in the future. A full analysis of these changes can be found in the Argus consulting strategy reports: *NPKs — A New Future* and *Micronutrients — The New Market Driver*. The need to supply a wider range of nutrients has undermined the old urea/diammonium phosphate approach, and has created challenges for blending in terms of access to suitable granular components and the distribution of small quantities of micronutrients in a blend. As such it will impact on every form of phosphate fertilizer in terms of manufacture and demand.

How these issues are affecting and will affect the main phosphate fertilizer groups is examined in the remainder of this section.

2.2. Implications for Phosphate Fertilizers

2.2.1. Ammonium Phosphates

Ammonium phosphates remain the most important route to the production of water-soluble fertilizers, and the most convenient products to transport and handle. They have in the past been used mainly as a seed-bed application and in blends and, in much smaller volumes, in steam granulation and compaction processes, where they require grinding before incorporation.

Among this group of fertilizers, diammonium phosphate (18-46-0) became the touchstone product during the 1970s and has retained this position. Purchasing specifications were generally built around product made in the US using Florida pebble phosphate rock. Over the past 10-15 years increasing volumes of monoammonium phosphate products have been produced and entered the export market. There are two main reasons for the gradual change:

- The entry into the international market of monoammonium phosphate from the FSU after its domestic market collapsed in 1990.

Monoammonium phosphate was the main phosphate fertilizer produced by FSU industries. Its availability led to acceptance on the global market;

- The gradual deterioration of rock quality, which makes it increasingly difficult to produce diammonium phosphate using ammonia and phosphoric acid alone, if it can be produced at all.

The development of 10-50-0 in the US had as much to do with the declining quality of Florida rock as market preference. Increased magnesium content makes it necessary to add urea to the ammonium phosphate slurry to achieve a nitrogen content of 18pc, which in turn can create operational problems such as foaming. The recent development of sulphur-enhanced ammonium phosphate products also helps the situation. Products such as Mosaic's MicroEssentials contain monoammonium phosphate, ammonium sulphate and micronized sulphur and other micronutrients can be added. This both solves problems with the ammonia-phosphoric acid reaction and allows greater volumes of finished product to be manufactured using the same volume of phosphoric acid.

Increasingly, new sources of phosphate rock contain high levels of magnesium, which can make it virtually impossible to manufacture 18-46-0 or even standard monoammonium phosphate 11-52-0, hence the spate of "mini-DAP" and mini-MAP products being produced in China. The same goes for rock in countries such as Vietnam and Kazakhstan. On the other hand, companies unable to produce diammonium phosphate may be persuaded to move to final production of NPKs rather than fight against the limitations created by unsuitable rock. Eventually, some of the mystique attached to diammonium phosphate may disappear. Until then, companies with good quality rock such as OCP and JPMC will be the only major players that can produce diammonium phosphate without recourse to a urea additive.

There is an exception to this rule, namely the Russian industry. In Russia, the high-quality apatite can produce extremely high-grade diammonium phosphate and monoammonium phosphate. However, investment in Russia is also focused on NPKs and NPS for a number of reasons:

- The domestic market is growing and companies want to sell final product to the consumer rather than an intermediate on which a blender shares a margin. In the case of Eurochem, a strategy of producing blend intermediates to serve its own blending and distribution arm in Russia has been dropped in favour of finished NPK production;

- The industry wants to participate in the growing export market for standard grade NPKs, driven by a change to the subsidy system in India. The in-house availability of nitrogen and the relatively low (state-controlled) price of potash for the Russian NPK industry have given exporters an advantage, over exporters such as OCP, GCT or JPMC and many of the US producers that have no direct access to ammonia on site.

There is one other important corollary to the impact of rock quality on the specification of diammonium phosphate — and it affects the reliability of specification and most notably, the export product produced in China. Export ammonium phosphates are produced by many smaller factories using a wide variety of phosphate rock feed. The result is a wide range of specifications, many of which do not conform to those laid down in government agencies' import regulations. Additionally, laboratory tests, which form part of the inspection process, reveal an even greater variation than that stated in the official specification.

Diammonium phosphate was once regarded as a standard product, but today it is ceasing to be so. The same applies to monoammonium phosphate.

2.2.2. Nitrophosphates

Large-scale nitrophosphate production is found mainly in northern Europe, Norway, Belgium, Austria and Russia. There is some production in China and India, and a few small plants elsewhere.

Generally, the process requires good quality rock, the preferred source for the Yara process traditionally being Russian apatite with 38pc or greater P_2O_5 content. The ODDA process now marketed by Uhde was originally based on Florida pebble phosphate, but since this quality of rock ceased to be mined there, plants have adapted to a wide variety of either sedimentary or igneous rocks. Given the high premium on Russian apatite, Yara has adapted its operational practices to allow the use of other (expensive) rock and or blending other lower-cost rock with Russian material to achieve a feed that optimises production of NP slurry and the co-product calcium nitrate or calcium ammonium nitrate. Yara is also considering investment in the supply of high quality rock to remove any residual dependence on Russian imports. On the other hand, the new Oleniy Ruchey mine operated by Acron might ease the availability and pricing of Russian apatite.

The nitrophosphate process is designed to produce high quality NPKs and convert the calcium contained in phosphate rock into a useful co-product rather than a disposal problem. It requires heavy investment and high quality rock and as such, is not generally a candidate for new investment. The high value of the main product plus co-product will ensure the future of the existing participants and even encourage expansion at existing plants. Yara has already increased NPK capacity at Porsgrunn by 300,000 t/yr. Acron may consider expanding NPK production depending on the quality of the apatite available from its new mine.

2.2.3. Superphosphates

The manufacture of superphosphates is straightforward compared with ammonium phosphates. The critical elements are the strength of the filter acid used and the P_2O_5-content of the secondary rock in the case of triple superphosphate. If either of these two production elements is not satisfactory, the final product will not contain the 46pc plant-available P_2O_5 expected in triple superphosphate or the 18-20pc P_2O_5 expected in single superphosphate. If the rock has a large iron and aluminium content or is igneous, issues of water solubility arise. The main constraint to growth in the production of triple superphosphate is lack of market acceptance. It is less freight efficient than ammonium phosphates and, critically, it is not compatible with urea in blending and difficult to use in steam granulation or compaction. As urea has become the major global solid nitrogen donor, this has proven a major setback.

Single superphosphate was once the major straight phosphate fertilizer worldwide. It provided a sink for the large tonnages of smelter acid that were available in developed countries, and provided a perfectly adequate fertilizer containing P_2O_5 and sulphur. Following World War 2 the industry began a gradual and apparently terminal decline as new, high analysis fertilizers were introduced. While this decline will never be reversed, there are signs that single superphosphate manufacture is growing and will continue to do so in a number of regions around the world. In respect of the rock feed, this renewed interest has a number of causes:

- The high cost of P_2O_5 is encouraging consideration of the exploitation of small deposits of rock, even of lower grade. If the rock is to be acidulated the only real option in terms of scale, processing options and cost, is single superphosphate. In many cases, poor quality rock is unsuited to phosphoric acid production but will produce a single superphosphate with 15-18pc available P_2O_5. Local availability of lower analysis product at a lower price per bag, is seen as a way to move agriculture forward in poor countries. The poorer the farmer, the less important the absolute P_2O_5 content and water solubility is, as the focus is on being able to provide some phosphate in a useful, affordable form;

- The sulphur content of single superphosphate has always been appreciated in certain agricultures and soil conditions. As sulphur deficiency spreads geographically, alternative means of supplying fertilizer sulphur are increasingly being considered and single superphosphate figures in such considerations;

- The importance of calcium is being recognised in terms of pH control and the release of other nutrients held in the soil to plants, especially in the African context. Single superphosphate may have a role to play in this regard.

The only rock that is not well suited to the production of single superphosphate is that containing high levels of silica. Such rock is found in Australia, which helps to explain why the industry produces phosphoric acid and ammonium phosphates from captive rock but imports rock to make 20pc P_2O_5 single superphosphate.

2.2.4. Direct Application Rock

Direct application rock comes under a number of different names and guises. It has been referred to as hyperphosphate, ground rock phosphate, reactive rock and direct application rock. The use of phosphate without thermal or acid attack originally referred to rock that, when finely ground, released plant-available P_2O_5 in certain soil and climatic conditions. The best known reactive rock is Tunisian Gafsa rock. Others are North Carolina rock (none is sold for direct application) and more recently Peruvian Bayovar rock. OCP has started mining a reactive rock in its Benguerir operation that is being sold as such, and in a number of compound formulations.

In addition to these highly reactive rocks, a number of medium reactive rocks have been introduced to the market, for example Israeli rock from Arad and Algerian rock from Djebel Onk. More recently, as a result of the rapid expansion of oil palm plantations in southeast Asia, rocks with a minimum P_2O_5 content of 27pc and minimum citric soluble P_2O_5 of 7pc are being used as such, either directly or combined in steam granulated or compacted compound fertilizers. Product for plantation use has been taken from Egypt, China, Syria and Vietnam — this is rock at the lower end of the price scale. Some of these lower-grade rocks are ground, mixed with a small quantity of sulphuric acid and granulated to produce a phosphate rock component suitable for blending. To become available to plants, the rock requires a minimum soil temperature of about 10ºC, high rainfall and a soil pH of less than 6.5.

As P_2O_5 prices rise and rock quality declines, there is likely to be further experimental work on cheaper routes to phosphate fertilization. The use of various types of reactive rock, often in combination with organic matter, is becoming a subject for study and testing. The small-scale steam granulation and compaction units now appearing in Europe, Latin America and Asia will be at the forefront of providing products that compete with mainstream fertilizers by using unacidulated rock, often not well suited to phosphoric acid manufacture. Organic mineral fertilizers will generally form a part of the product mix.

Chapter 3: Phosphoric Acid

3.1. The Phosphoric Acid Industry

An overwhelming proportion of phosphoric acid is consumed captively in vertically integrated operations, and as such is an intermediate. Supply considerations in respect of this acid are geared to the market for the downstream end-products — mainly ammonium phosphate/NPK and to a lesser extent triple superphosphate and technical products.

The following breakdown of phosphoric acid production and trade demonstrates the relatively static performance of merchant acid within the phosphate sector over the period 2000-13, excluding the sharp contraction of 2008-09:

Table 1-5: World Phosphoric Acid Production and Trade *mn t* P_2O_5

	2000	2006	2007	2008	2009	2010	2011	2012	2013	±2000-13
Production	27.9	34.1	36.9	34.1	33.7	40.2	42.3	41.8	42.5	14.6
Trade	4.6	4.8	4.7	4.0	4.4	4.7	4.4	4.2	4.0	-0.6
										— IFA

The sources of merchant acid have remained the same over many years, whereas there have been significant changes in acid production.

Table 1-6: World Phosphoric Acid Production by country, 2000-13							'000t P_2O_5
	2000	2008	2009	2010	2011	2012	2013	±2000-13
World Total	**27,849**	**34,109**	**33,740**	**40,229**	**42,268**	**41,722**	**42,535**	**14,686**
W Europe	**2,051**	**1,709**	**1,150**	**1,558**	**1,406**	**1,330**	**1,275**	**(844)**
Belgium/Lux.	286	180	100	230	230	230	**250**	**(36)**
Bulgaria	73	104	58	99	117	109	**92**	**19**
Finland	265	259	232	227	241	262	**268**	**3**
Greece	120	56	47	63	54	30	**37**	**(83)**
Lithuania	297	398	440	431	444	429	**447**	**150**
Poland	375	305	150	300	320	270	**182**	**(194)**
Spain	378	322	95	208	-	-	**-**	**(378)**
Other	257	85	28	-	-	-	**-**	**(324)**
EECA	**2,477**	**2,855**	**2,627**	**3,165**	**3,162**	**3,169**	**3,035**	**625**
Belarus	90	107	115	129	121	142	**118**	**28**
Russia	1,905	2,322	2,132	2,574	2,509	2,554	**2,529**	**624**
Turkey	282	166	179	182	219	176	**167**	**(115)**
Other	200	260	202	281	244	297	**221**	**88**
Africa	**5,273**	**5,296**	**5,559**	**6,541**	**6,129**	**5,652**	**6,278**	**1,005**
Morocco	2,736	2,770	3,068	3,984	4,404	3,864	**4,444**	**1,708**
Senegal	295	190	283	313	392	363	**260**	**(35)**
South Africa	752	872	735	623	613	425	**482**	**(270)**
Tunisia	1,460	1,430	1,470	1,620	700	950	**1,050**	**(410)**
Other	30	35	3	-	21	50	**41**	**11**
N America	**10,537**	**8,182**	**7,532**	**8,375**	**8,748**	**8,227**	**8,508**	**(2,029)**
Canada	254	305	281	284	324	266	**290**	**36**
US	10,283	7,877	7,251	8,091	8,424	7,961	**8,218**	**(2,065)**
Lat.America	**1,683**	**1,674**	**1,465**	**1,702**	**1,719**	**1,951**	**1,849**	**166**
Mexico	627	488	431	592	619	622	**575**	**(52)**
Brazil	923	1,084	913	1,075	1,039	1,287	**1,258**	**335**
Venezuela	133	102	121	35	61	42	**16**	**(117)**
Middle East	**1,460**	**1,198**	**1,091**	**1,319**	**1,388**	**1,846**	**2,050**	**590**
Iran	96	-	-	30	30	30	**35**	**(61)**
Iraq	90	-	-	-	-	-	**20**	**(70)**
Israel	520	550	457	521	514	504	**576**	**56**
Jordan	543	460	471	527	484	447	**470**	**(73)**
Lebanon	122	130	110	180	160	120	**80**	**(42)**
Syria	89	58	53	61	60	30	**25**	**(64)**
South Asia	**1,014**	**1,220**	**1,168**	**1,529**	**1,723**	**1,414**	**1,422**	**408**
Bangladesh	17	18	8	25	25	20	**22**	**5**
India	997	1,202	1,160	1,504	1,698	1,395	**1,400**	**403**
Southeast Asia	**386**	**169**	**136**	**394**	**444**	**450**	**387**	**1**
Indonesia	131	100	30	205	198	207	**210**	**79**
Philippines	175	69	106	117	146	113	**77**	**(98)**
Vietnam	-	-	-	72	100	130	**100**	**100**
Thailand	80	-	-	-	-	-	**-**	**(80)**
East Asia	**2,816**	**11,373**	**12,551**	**15,167**	**17,167**	**17,480**	**17,332**	**14,516**
China	2,200	10,900	12,260	14,800	16,800	17,000	**17,100**	**14,900**
Japan	203	153	76	104	117	104	**75**	**(128)**
South Korea	413	320	215	262	250	176	**157**	**(256)**
Oceania	**152**	**433**	**461**	**481**	**450**	**321**	**401**	**249**
Australia	152	433	461	481	450	321	**401**	**249**

— IFA; EECA-East Europe/Central Asia

- In 2000-13 world phosphoric acid production increased by 14.7mn t P_2O_5. This increase largely reflects developments in China, which has seen enormous growth in production. The impact of the 14.9mn t P_2O_5 increase in China during this period has been felt primarily in the markets for diammonium phosphate and, to a lesser extent, monoammonium phosphate and NPK;

- Moroccan production increased by around 1.7mn t P_2O_5 in 2000-13.
- US production declined by 2.1mn t P_2O_5 in 2000-13. This long-term trend of falling production was reinforced by the closure in 2014 of PCS's Suwannee River plant. While the closure will be partially offset by increased operating rates at the Aurora North Carolina facility, PCS anticipates a net loss in production of 215,000t P_2O_5 by 2015. The granulation facilities at White Springs will continue to operate and it is assumed that the company will stop exporting around 200,000 t/yr to Coromandel and IFFCO in India. Another development contributing to the decline in US production is the closure of Mississippi Phosphates' Pascagoula plant which declared Chapter 11 bankruptcy in October 2014 and ceased phosphoric acid and DAP production in December 2014.
- Tunisian production declined by 410,000t P_2O_5 in 2000-13, as its phosphoric acid and DAP facilities have been running at significantly reduced rates since 2011 because of a shortage in mined phosphate rock caused by local strikes in Tunisia. The Tifert plant in Tunisia, a 365,000 t/yr phosphoric acid joint venture between GSFC, Coromandel and GCT, started production in September 2013 in Skhira. Tifert shipped around 260,000t of phosphoric acid to its Indian shareholders in 2014. The plant has not yet achieved full production capacity because of various issues related to funding, phosphate rock grade and management problems.
- The overall European balance has remained roughly the same, with a 844,000t P_2O_5 decline in west European production, which includes the closure of the Fertiberia plant in Spain in 2011, and a 625,000t P_2O_5 increase in eastern Europe (including Turkey), mostly accounted for by Russia.
- Elsewhere in the world, production has not seen significant shifts. The largest changes were in Australia and India, which saw an increase of about 170,000t P_2O_5 and 560,000t P_2O_5, respectively, while production in Brazil grew by 360,000t. South Korean production declined by 240,000t P_2O_5. Production increased slightly in Tunisia in 2000-10, but recent political turbulence has seen a sharp fall in production of 410,000t P_2O_5 to 1.05mn t from 2000-13.

Trade in merchant grade phosphoric acid is restricted. Only a handful of producers have the terminal facilities to offer merchant acid, and only a handful of fertilizer producers have the receiving terminals to take it. The reason for this is relatively straightforward — the cost of receiving and then processing merchant acid into ammonium phosphates and ammonium phosphate-based fertilizers traditionally rendered the end product uncompetitive compared with phosphate rock on the one hand or finished products imported or produced at a local vertically integrated complex on the other hand. This manufacturing route is only able to survive in countries where there is a system of government subsidy available for production based on purchased acid. The same is not the case for higher-value technical products, such as detergents or, in some situations, animal-feed additives, but the volumes required for this sector are comparatively small. Only 10pc of world phosphoric acid production goes into non-fertilizer products and much of this is processed captively.

As the number of non-basic fertilizer plants reduces, producers of merchant acid are likely to reconsider the pricing of merchant acid under the umbrella of long-term supply arrangements and joint-venture agreements. For phosphate exporting industries such as OCP and JPMC, it is important to keep a balance between the various export products. Pricing has to reflect the fact that it is not practical to process all rock into finished product in situ. In short, existing customers for rock and acid need to remain competitive and joint ventures may prove the most convenient way to move rock and acid for processing to final fertilizers in the market. The development of backhaul opportunities for vessels bringing palm oil from southeast Asia has somewhat enhanced the opportunities for phosphoric acid sales/joint ventures in the region.

Table 1-7: World Phosphoric Acid Imports, 2000-13							'000t P_2O_5
	2000	2008	2009	2010	2011	2012	2013	±2000-13
World Total	4,489	4,026	4,444	4,746	4,405	4,198	4,033	(455)
West Europe	1,106	785	577	819	847	907	770	(339)
Belgium/Lux	243	135	98	180	174	130	98	(145)
France	146	147	102	228	139	207	194	48
Netherlands	152	214	140	129	105	158	136	(16)
Other	565	290	238	283	429	412	343	(225)
EECA	145	144	204	323	220	220	191	49
Turkey	142	140	197	317	213	215	185	43
Other	3	4	7	5	7	5	6	6
Africa	53	31	38	66	37	33	31	(22)
North America	55	239	120	104	123	126	103	48
Canada	40	198	73	61	65	51	33	(8)
US	15	41	47	42	30	75	71	56
Latin America	176	319	228	300	287	279	218	42
Mexico	22	115	116	110	74	81	86	64
Brazil	141	169	88	163	151	91	84	(57)
Other	13	35	24	28	62	106	48	35
Middle East	246	117	126	145	104	142	89	(158)
Iran	85	19	21	32	5	4	1	(84)
Israel	-	0	1	0	1	0	0	0
Jordan	-	0	2	1	0	0	0	0
Saudi Arabia	161	94	95	98	78	127	83	(79)
Other	-	4	7	14	21	11	5	5
South Asia	2,404	2,123	2,940	2,617	2,406	2,049	2,183	(221)
Bangladesh	4	11	18	40	25	8	45	41
India	2,260	1,892	2,639	2,263	2,057	1,729	1,811	(449)
Pakistan	140	219	283	314	324	313	327	187
Other	-	-	0	-	-	-	-	0
Southeast Asia	61	124	83	247	234	278	259	198
Indonesia	22	51	45	196	180	221	208	186
Philippines	2	2	2	3	2	2	2	(0)
Vietnam	2	1	1	1	1	2	2	0
Other	35	71	34	47	51	52	48	13
East Asia	61	99	114	97	110	109	126	65
Oceania	44	12	9	14	10	12	10	(35)
Australia	44	10	8	13	9	11	8	(36)
Other	-	1	1	1	1	1	1	1
Unspecified/Other	138	33	5	15	27	44	54	(84)

— IFA; EECA-East Europe/Central Asia

Table 1-8: World Phosphoric Acid Trade Matrix, 2013 *'000t P_2O_5*

	Exporter									
Importer	**US**	**China**	**Morocco**	**Senegal**	**S Africa**	**Tunisia**	**Israel**	**Jordan**	**Other**	**Total**
World Total	**497**	**285**	**1,914**	**255**	**213**	**301**	**185**	**163**	**220**	**4,033**
Europe	**-**	**39**	**432**	**-**	**29**	**212**	**96**	**19**	**134**	**961**
Latin Am.	**138**	**22**	**25**	**-**	**-**	**-**	**-**	**8**	**24**	**217**
Brazil	60	2	21	-	-	-	-	-	1	84
Other Latin Am.	78	20	4	-	-	-	-	-	31	133
South Asia	**330**	**13**	**1,326**	**255**	**129**	**66**	**48**	**17**	**0**	**2,183**
India	330	8	981	255	123	66	48	-	0	1,811
Pakistan	-	4	323	-	-	-	-	-	0	327
Other S Asia	-	1	22	-	6	-	-	17	0	45
SE Asia	**-**	**70**	**65**	**-**	**34**	**-**	**-**	**91**	**0**	**260**
East Asia	**-**	**89**	**-**	**-**	**18**	**17**	**-**	**3**	**0**	**126**
Other/ Unspecified	29	52	66	-	3	6	41	25	64	286

— IFA

A closer analysis of the trade figures reveals that just a few major participants dominate the market:

- Morocco and India alone account for almost half of world exports and imports, respectively, of phosphoric acid. Morocco exported 1.9mn t of phosphoric acid in 2013. Apart from Morocco, there are few other significant exporters of phosphoric acid. Those generally exporting more than 150,000 t/yr P_2O_5 are highlighted in the table below:

Table 1-9: Major Exporters of Merchant Phosphoric Acid, 2000-13								'000t P_2O_5
	2000	2007	2008	2009	2010	2011	2012	2013
World Total	**4,490**	**4,694**	**4,027**	**4,444**	**4,746**	**4,406**	**4,199**	**4,033**
West Europe	**465**	**281**	**248**	**201**	**181**	**173**	**191**	**159**
Belgium/Lux	266	160	113	90	114	110	110	**111**
Finland	131	94	85	85	50	63	81	**48**
Spain	22	23	50	25	18	-	-	-
Other	46	4	0	0	-	0	-	-
EECA	-	**0**	**0**	-	-	-	-	-
Africa	**2,782**	**3,395**	**2,686**	**3,101**	**3,420**	**3,042**	**2,732**	**2,683**
Morocco	1,548	2,133	1,531	1,836	2,243	2,088	1,817	1,914
Senegal	233	205	183	282	308	366	350	255
South Africa	420	514	585	477	343	338	205	213
Tunisia	581	544	387	506	525	250	360	301
North America	**260**	**404**	**502**	**383**	**433**	**492**	**468**	**497**
US	260	404	502	383	433	492	468	497
Latin America	**26**	**49**	**38**	**7**	**23**	**49**	**135**	**40**
Mexico	24	48	38	7	23	46	135	40
Middle East	**707**	**260**	**192**	**409**	**319**	**267**	**333**	**348**
Israel	393	136	67	248	153	130	194	185
Jordan	314	124	125	161	166	136	138	163
Southeast Asia	**65**	-	-	-	**6**	-	-	-
Philippines	65	-	-	-	6	-	-	-
East Asia	**73**	**231**	**309**	**279**	**270**	**309**	**284**	**285**
China	73	202	287	276	270	309	281	285
South Korea	-	29	23	2	-	-	3	-
Oceania	-	-	-	-	-	-	-	-

— IFA

- Europe is primarily an importer of acid for technical use. There is some use of acid in NPKs but the closure of the Rouen unit of Grande Paroisse reduced off-take to a few smaller participants. Historically, there could be a small amount of double counting of trade in Europe, as product crosses a number of borders. For example, in some years — although not recently — the Czech Republic is reported to have exported around 20,000 t/yr of P_2O_5, but the country operates no acid plants.

  The hub of activity is Belgium, where technical grades of acid were supplied from the 135,000 t/yr Rieme acid plant owned by Nilefos (formerly Rhodia), until the company's bankruptcy in 2010. Phosphoric acid production has been terminated and the contaminated land and gypstack are undergoing rehabilitation to free the land for other uses. The Prayon plant, which imports purified acid from OCP, its part-owner, also takes high-grade Russian apatite. The companies have announced investment in the production of technical phosphate products in Morocco. In the past, Spain shipped small volumes, mainly from Huelva to Fertiberia's Portuguese subsidiary at Setubal (some phosphoric acid was also railed to Fertiberia's Aviles plant in the north of Spain for NPK production there). However, Fertiberia closed the four streams of its Huelva acid capacity permanently in 2010-11 as a result of the Huelva complex's long-standing environmental problems in respect of phosphogysum run-off into the river estuary. The company subsequently had an agreement with OCP to supply 150,000 t/yr of phosphoric acid (instead of phosphate rock) but in November 2013 announced that the plant would be closed permanently, having been idled in September 2013. France has generally imported 150,000-230,000 t/yr, but the termination of chemical NPK production may reduce this requirement.

Turkey tends to import 200,000 t/yr, but the country took almost 320,000t in 2010. Toros has three small units, one at Mersin (70,000 t/yr) and two at Samsun (86,000 t/yr and 118,000 t/yr) for DAP/NPK production, but requires imports for NPKs at Ceyhan. OCP signed a joint-venture agreement with Toros in 2011, and supplies both rock and phosphoric acid to the company. The complexes have been refurbished and expanded. The additional capacity will serve the export market (both Samsun and Mersin are port cities). Elsewhere, Bagfas has DAP/NPK production at Bandirma, based on an acid plant with 150,000 t/yr capacity. Ege Gubre Sanayaii at Izmir produces either diammonium phosphate or NPKs on the basis of imported acid and IGSAS Yarimca produces NPKs at the company's nitrogen facility at Izmit.

Morocco accounted for almost half of phosphoric acid trade in Europe in 2013, including shipments to its subsidiary in Belgium. Tunisia and Israel together exported around 310,000t P_2O_5 to Europe in 2013;

- In recent years, the US has exported 400,000-500,000 t/yr of acid. In 2013, total exports stood at 497,000t P_2O_5. Of this, 330,000t P_2O_5 involved the shipment of PCS tonnage to IFFCO and Coromandel in India. As mentioned above, the closure of the company's Suwannee River unit will see the net loss of 215,000t P_2O_5 of capacity and the likelihood of an end to these exports. In addition small volumes of US product move to Canada (28,000t P_2O_5 in 2013) and Mexico (78,000t P_2O_5 in 2013). These shipments are also likely to decline as the US industry consolidates. According to the Fertilizer Institute, 2014 phosphoric acid exports dropped by 25pc from 2013 to around 360,000t with lower demand from all US export destinations, mainly India;

- Brazil and Mexico are the only major importers in Latin America and both have reduced purchases in the last 2 years to below 100,000 t/yr P_2O_5. US producers supplied the majority of tonnage in 2013;

- India dominates both global and south Asian trade. Imports totaled 1.8mn t P_2O_5 in 2013, up by 100,000t from 2012 levels but down overall from a peak of 2.3mn t P_2O_5 in 2010, reflecting the growing availability of ammonium phosphates from Saudi Arabia and China, as well as availability of NPKs. More than 50pc of Indian imports came from OCP, followed by the US and Senegal. Overall, the lion's share of Indian imports comprises joint-venture material (which represent a kind of vertical integration at arm's length) or long-term supply arrangements and relatively little is purchased on the open market, with the exception of the US tonnage

(330,000t P_2O_5 in 2013) which will certainly decline with the closure of PCS's plant in 2014.

Senegal (ICS) supplies the Indian market through its joint venture with IFFCO. IFFCO imported around 250,000t P_2O_5 from ICS in 2013 down by 100,000t from the 350,000t imported in 2012. Preliminary shipment line ups indicate that the same imports stood at around 260,000t in 2014. The decline in Senegal exports of phosphoric acid from 2012 is believed to be linked to ICS having production issues related to its sulphur supply.

South African exports to India stood at 123,000/t P_2O_5 in 2013, down from 234,100t P_2O_5 in 2011, as a result of the poor performance of Foskor's Richards Bay plant.

Imports from Jordan have declined from 120,000t P_2O_5 in 2008 to nothing in 2012 and 2013. However, phosphoric acid exports from Jordan to India will resume in 2015 with the commissioning of the JIFCO plant in December 2014, a 500,000 t/yr phosphoric acid plant owned by the Indian fertilizer corporation IFFCO (52pc) and JPMC (48pc) and located in Eshidiya, Jordan. The aim of the joint venture is to reduce India's dependence on any one supplier or any one phosphate-containing product.

Pakistan is the only other major importer in the region at present, with virtually all of the country's 326,700t P_2O_5 supply in 2013 coming from its joint-venture partner OCP. Bangladesh has built two ammonium phosphate units based on imported acid, but not as part of a joint venture. The units imported 45,000t P_2O_5 in 2013, up from 8,000t the previous year. Bangladesh was traditionally a market for superphosphates and the diammonium phosphate units were built under heavy pressure from major aid donors China and Japan, both keen to support their own contracting industries with aid-financed projects. The result of this failed investment is that the market has switched away from superphosphates and towards diammonium phosphate but in the current market finds it easier to import;

- In the Middle East, Saudi Arabia is the major player, although its imports have declined from 127,000t P_2O_5 in 2012 to 82,500t in 2013 and 62,000t in the first nine months of 2014. With the Ma'aden Phosphate complex failing to operate at much more than 75pc utilisation, it seems that imports will continue at least until the start-up of the new announced joint venture with Mosaic that will produce an additional 1.5mn t/yr of phosphoric acid capacity for the development of various downstream fertilizer and non-fertilizer products. It is expected to start up in 2017-18;

- The southeast and east Asian region is not a big importer of merchant phosphoric acid, taking 386,000t P_2O_5 in 2013. The developed countries of east Asia import mainly for technical use, accounting for about one-third of trade. Indonesian imports totalled 207,800t P_2O_5 in 2013, with the Gresik plant the largest single importer. PT Petrokimia Gresik is also the only Indonesian acid producer currently in operation and is currently expanding its own acid capacity, which will be doubled to 400,000 t/yr by mid 2015, thus reducing its acid import requirement. PT Petrokimia Gresik has also completed a joint venture acid plant with Jordan (PT Petro Jordan Abadi) located in Gresik, Java, that was brought on stream in the second half of 2014 and will produce 200,000 t/yr of phosphoric acid. The joint venture has a contract in place with JPMC to supply around 770,000 t/yr of rock for the next 20 years and the acid produced will be used as a feedstock at a 1mn t/yr NPK plant. This is the first of three similar JV plants between the state-owned PT Pupuk Indonesia Holding and JPMC. All three of the plants are based on Jordanian rock, and the acid will be used as a feedstock for 3mn t/yr new NPK capacity to be built in Indonesia. The construction of the second 200,000 t/yr phosphoric acid plant — PT Pupuk Kalimantan Timur (Pupuk Kaltim) — will be commissioned in 2017 as construction is planned to start in early July 2015. The third 200,000 t/yr acid plant is a JV between JPMC and PT Pupuk Sriwijaya (Pusri) and will be located in South Sumatra. It is assumed to come on stream in 2018.

- According to customs statistics China has exported 200,000-300,000 t/yr of acid in recent years, with 2013 exports standing at 285,000t. The recorded volumes are small and globally disparate, with the largest volumes moving to Taiwan, South Korea and Thailand (30,000-40,000 t/yr P_2O_5 each). With declining rock quality, China is struggling to produce good quality standard monoammonium phosphates and diammonium phosphate. It is likely that these exports have been encouraged by a lack of export duty on phosphoric acid, but the trends for Chinese phosphate supply suggest that, with or without duty, phosphoric acid exports will eventually erode as the tonnage is absorbed into local production.

3.2. The Outlook for Phosphoric Acid

The merchant phosphoric acid market has been static for many years — in the range of 4mn-5mn t/yr P_2O_5, although increased competition in the ammonium phosphate market has seen world trade at just above 4mn t/yr P_2O_5 over the last two years. The added cost of producing and shipping acid from one industrial complex for further processing in a second industrial process only makes economic sense in a few locations:

- It is costly to ship merchant acid in specialised chemical tankers, although the development of a back-haul business based on palm oil from southeast Asia is changing trade dynamics;

- Shipped 54pc P_2O_5 solution has about the same phosphate content as a high-grade monoammonium phosphate (52pc P_2O_5), and less in absolute terms (N+ P_2O_5) than either diammonium phosphate or monoammonium phosphate, both of which are shipped much more cheaply in bulk;

- The energy integration that can be achieved at a site burning sulphur supports both acid concentration, where necessary, and granulation. This energy bonus is lost when production is based on purchased acid, apart from the heat associated with the reaction between ammonia and phosphoric acid.

This is not a theoretical calculation — plants in Europe based on imported acid have been uncompetitive with Huelva the most recent to be closed in Spain. Thai National Fertilizer set up a new complex in the 1990s that went bankrupt soon after commencing operations. For this reason, the overwhelming majority of acid for use in fertilizer manufacture is shipped to India and Pakistan, where production subsidies are available. A world-wide withdrawal of government involvement in the industry and the removal of state subsidies have resulted in a stagnant market for phosphoric acid. As in the past, new capacity will be confined to a handful of joint-venture projects mainly involving OCP or JMPC. Such ventures are strategically and politically inspired and difficult to forecast on the basis of economic data. The Jorf Phosphate Hub in Morocco will offer joint ventures the option to ship phosphoric acid or solid products. In March 2014, OCP signed a joint venture project with the Gabon government which will include the shipment of 450,000 t/yr of phosphoric acid from OCP to Gabon for upgrading at a new ammonia production site at Port Gentil.

There is a lack of activity in new construction, with the exception of the Jorf programme which will see four new units come on stream within the end of 2016. The Jorf Hub has had a deterrent effect on new investments, but less so than the massive expansion in China. Chinese acid production rose from 9.7mn t P_2O_5 in 2007 to 17.1mn t P_2O_5 in 2013. Outside China and Morocco, a few small units have been built, for example in Vietnam, and we have seen small revamp expansions, cancelled out by plant closures. Global acid production excluding China stood at 26.2mn t in 2007, compared with 25.4mn t in 2013.

The outlook for the short term is more of the same. There is significant expansion of capacity at various sites in Brazil, for example, but the approach is to invest in major refurbishments such as Vale's phosphoric acid complex at Uberaba, which was formerly owned by Bunge-Fosfertil. The two original acid streams were supplemented by an additional train that was planned and managed in-house. Other in-house modifications have been made to evaporators, filters, heat exchangers and many other items of equipment. The plant's original output was 296,000 t/yr P_2O_5. After the first expansion phase in 1998, which included an additional acid attack and filtration system, it increased to 400,000 t/yr P_2O_5. A second revamp phase was completed, adding two new evaporators and raising capacity to 910,000 t/yr P_2O_5. Vale's Salitre phosphate rock project at Patrocinio, Minas Gerais was intended to create a platform for further expansion. The company was proposing to construct downstream MAP/DAP/TSP capacity at the site. The project was delayed during the fertilizer market downturn in 2008-09 and still awaits Vale board's approval. On the other hand, the decision by Anglo-American not to divest the Copebras operation has given the go-ahead for the rock/processing complex at Catalao to produce an additional 800,000-900,000t of monoammonium phosphate and triple superphosphate in 2020-21 adding some 450,000 t/yr of acid to the complex.

Outside China, only Morocco has firm plans for new phosphoric acid plants. In the course of OCP's current five-year plan, acid output at Jorf Lasfar has been increased substantially through revamp work. The company installed two 450,000 t/yr granulation units in September 2010 to allow further flexibility to respond to demand fluctuations for merchant acid versus final product and two more were added in 2013. Line E, a phosphoric acid unit with a capacity of 450,000t P_2O_5 was commissioned in May 2014. Some of the existing joint-venture plants have also been upgraded, for example Imacid which production capacity has been expanded from 375,000 t/yr P_2O_5 to 430,000 t/yr P_2O_5.

OCP has also started the construction of four integrated DAP/MAP units at the Jorf Lasfar site, under the Jorf Phosphate Hub programme (JPH) with a capacity of 450,000 t/yr P_2O_5 each (around 1mn t/yr DAP/MAP) to be built at six-months intervals between 2015 and 2016. The first is due on stream in July 2015. The second should come on stream in the fourth quarter of 2015. We assume that the Gabon joint venture project will proceed by 2019, with two other phosphoric acid plants coming on-stream, one of which will be used to supply a 1mnt/yr granulation unit at Jorf, while the other will supply phosphoric acid to a granulation unit to be built in Gabon. The remaining four JPH units are assumed to come on-stream during the subsequent 5 years or so.

Table 1-10: Moroccan Phosphoric Acid Capacity		*'000 t/yr P_2O_5*
	2014	**2015-16**
Total Capacity	**4,790**	**6,830**
Of which:		
Safi	**1,560**	**1,560**
Jorf Lasfar	**3,230**	**5,085**
Of which:		
Maroc Phosphore	1,900	1,900
Imacid, Jorf Lasfar (JV Chambal/Tata)	430	430
Emaphos, Jorf Lasfar (PPA)	150	150
Pakistan Maroc Phosphore (OCP/Fauji)	375	430*
Jorf Fertilizer Company (ex- OCP/Bunge)	375	375
Jorf Phosphate Hub I-IV		4x450

** The rise accounts for (i) an increase in efficiency and (ii) better yield achieved through the transition to slurry phosphate.*

— Company reports

On the other hand, OCP is investing in the development of the new Safi complex under the Safi Phosphate Hub programme (SPH), through the addition of further integrated fertilizer production units and the transfer of the current assets to a new platform which will enable ammonia imports from the new Safi port currently under construction. The SPH platform is expected to start operations in 2021, with a phosphoric acid capacity of around 2.5mn t P_2O_5 along with associated granulation capacity for the production of NPKs, Feed Phosphates, and TSP. A further integrated DAP/MAP unit with a capacity of 450,000 t/yr DAP/MAP is expected to come on stream in 2022, bringing the total phosphoric acid capacity of the SPH platform to almost 2.8mn t P_2O_5.

Last but not least, the addition of downstream capacities at Boucraa and the development of the Laayoune port are currently under study.

After the completion of currently scheduled projects, increases in production in China are likely to be on a much smaller scale than in the recent past, and mainly based on expansions and revamps. Some smaller-scale units will be closed.

The 500,000 t/yr phosphoric acid JIFCO joint venture at Eshidiya, Jordan, is expected to operate at full capacity by the end of 2015. As mentioned earlier, the Tifert phosphoric acid plant in Tunisia is yet to ramp up to full production capacity and should increase its exports to India accordingly. A number of companies have plans to construct phosphoric acid and ammonium phosphates capacity but these cannot be regarded as firm.

3.3. Main Conclusions

The following main conclusions emerge from the analysis:

- The market for merchant-grade phosphoric acid is static. The only major complexes expected to be built in the foreseeable future will involve a joint-venture off-take partner. In some cases, a partner will offer access to a market where the government offers production subsidies and/or control over prices. In other cases major exporters such as OCP may seek to gain or consolidate market position by effectively tolling acid through plants facing the risk of closure. As phosphogypsum problems closed down plants such as Pasadena, Rieme, and Huelva, OCP started replacing long-standing rock supply contracts with phosphoric acid, with a price formula related to final product prices. In the case of Huelva, this apparently only proved to be a short-term solution;

- On the other hand, US exports are expected to erode with the loss of 215,000 t/yr of acid exports following the closure of PCS's Suwannee River capacity in the second half of 2014. Chinese exports of phosphoric acid are also expected to decline in the longer-term. OCP with its production flexibility is well placed to make up any short-fall;

- Outside China and Morocco there are no firm projects for new acid plants, with or without downstream facilities, which are not already under construction. The rate of construction in China has been so great that the rest of the global industry is wary of major investment. The only growth can be seen through joint ventures guaranteeing off-take or by the revamping of existing complexes. All but 1mn t/yr P_2O_5 of incremental production outside China since 2000 has been offset by plant closures elsewhere;

- The impact of the Ma'aden investment, as well as Chinese exports of diammonium phosphate, have cast doubt on future trade in phosphoric acid for fertilizer manufacture. A surge in export availability of ammonium phosphates is having an impact on Indian policy, which adds to investment nervousness;

- OCP's Jorf Lasfar assets now have sufficient downstream granulation capacity to absorb more than total feasible phosphoric acid production;

- Plans for the development of triple superphosphate plants at M'dhilla and Skhira and ammonium phosphate facilities at Gabes all point to a similar underlying strategy in Tunisia, which is the ability to reduce shipments of merchant acid if need be without shutting down plants. For the time being, these and other private sector projects in Tunisia are on hold.

Chapter 4: Triple Superphosphate

4.1. The Triple Superphosphate Industry

Triple superphosphate is produced by reacting phosphate rock with phosphoric acid to produce a 46pc P_2O_5 fertilizer. From the perspective of phosphate rock producers, triple superphosphate has often been preferred to its main competitor, ammonium phosphate, for a number of reasons:

- About two-thirds of P_2O_5 derives from the phosphoric acid and one-third from the secondary rock with which it is reacted. This offers an effective bonus of a third of a tonne of phosphoric acid compared with ammonium phosphate, where all of the P_2O_5 contained is derived from the acid plant. As a corollary, consumption of sulphuric acid is lower per tonne of product and phosphogypsum output is reduced. A 1,000 t/d phosphoric acid plant will produce 30pc more final product if it is used to produce triple superphosphate rather than diammonium phosphate and slightly more when compared with monoammonium phosphate with an 11-52-0 formulation. On the downside, it does require greater granulation capacity to achieve the same volume of throughput (product moves through the granulator at a slower rate to allow the reaction between phosphoric acid and phosphates rock);

- Triple superphosphate eliminates the need to purchase ammonia, which is then processed and re-exported. With the exception of Ma'aden, practically every major producer of diammonium phosphate is dependent on the purchase of ammonia, which bears a substantial freight element in the cfr cost. The North African industries embarked on their major expansion programmes in the late 1970s intending to focus on merchant phosphoric acid and triple superphosphate. Only in the 1980s did Tunisia and Morocco invest in diammonium phosphate capacity.

The straight P_2O_5 strategy did not work. The following table clearly demonstrates the failure to promote triple superphosphate as a real competitor to ammonium phosphates in the global P_2O_5 market.

Table 1-11: World Triple Superphosphate Production and Trade *mn t P_2O_5*

	1985	1990	2000	2005	2007	2010	2011	2012	2013
Production	5.4	4.5	2.3	2.5	2.6	2.9	3.1	2.7	2.5
Trade	2.1	1.5	1.4	1.6	1.8	1.8	1.8	1.5	1.5

— IFA

Triple superphosphate production has more than halved since 1985. There has been some minor fluctuation in availability as the Chinese authorities have adjusted export tariffs and the market has reacted to new supplies and the loss of output from Tunisia and Lebanon. Rather like merchant phosphoric acid, the production and use of triple superphosphate tends to be focused on a handful of major companies that are increasingly dealing with a niche product. The following sub-section highlights the status of existing capacity.

4.1.1. Triple Superphosphate Capacity

Definitions

- The following description of capacity focuses on plants with a production of 46pc available P_2O_5 triple superphosphate of more than 50,000 t/yr. The few remaining plants that produce small volumes of product below 46pc are excluded;
- These plants are in nearly all cases based on captive phosphate rock and phosphoric acid;
- The production of triple superphosphate fluctuates annually in a narrow band. This depends on a number of factors, including the needs of the market for merchant phosphoric acid and ammonium phosphates. There is an inbuilt flexibility between the production of merchant acid, triple superphosphate, monoammonium phosphate and diammonium phosphate in a number of production complexes. In the few instances where new capacity is planned, there is generally no certainty that triple superphosphate will be the main product. For this reason capacities tend to be overstated. Where plants are capable of producing either ammonium phosphates or triple superphosphate there is no definitive capacity for either. In these cases the highest recent output figure is taken as the capacity;
- In practice the operational preference is to dedicate production campaigns or a granulation stream entirely to triple superphosphate rather than to switch on a regular basis.

Table 1-12: TSP Capacity 2014-21 *'000 t/yr*

Region	Country	Company	Location	2014	2015	2016	2017	2018	2019	2020	2021
World Total				**7,325**	**7,325**	**7,155**	**7,325**	**7,325**	**7,325**	**7,535**	**8,250**
West Europe				**260**	**260**	**260**	**260**	**260**	**260**	**260**	**260**
West Europe	Bulgaria	Agropolychim	Devenya	260	260	260	260	260	260	260	260
EECA				**185**	**185**	**185**	**185**	**185**	**185**	**185**	**185**
EECA	Turkey	Gubretas Fabrikilari	Yarimca	185	185	185	185	185	185	185	185
Africa				**2,165**	**2,165**	**1,995**	**2,165**	**2,165**	**2,165**	**2,165**	**2,665**
Africa	Egypt	Polyserve	Abu Zabaal	100	100	100	100	100	100	100	100
Africa	Morocco	OCP	Jorf Lasfar	270	270	270	270	270	270	270	270
Africa	Morocco	OCP	Safi (current)	1,000	1,000	1,000	1,000	1,000	1,000	1,000	-
Africa	Morocco	OCP	Safi SPH	-	-	-	-	-	-	-	1,500
Africa	Tunisia	GCT	Sfax 1	165	165	80	-	-	-	-	-
Africa	Tunisia	GCT	Sfax 2	165	165	80	-	-	-	-	-
Africa	Tunisia	GCT	Mdhilla	233	233	233	233	233	233	233	233
Africa	Tunisia	GCT	Mdhilla	233	233	233	233	233	233	233	233
Africa	Tunisia	GCT	Mdhilla 2				330	330	330	330	330
Latin America				**1,405**	**1,405**	**1,405**	**1,405**	**1,405**	**1,405**	**1,615**	**1,830**
Latin America	Mexico	Grupo Fertinal	Lazaro Cardenas	50	50	50	50	50	50	50	50
Latin America	Mexico	Innophos	Veracruz	250	250	250	250	250	250	250	250
Latin America	Brazil	Anglo American	Catalao, Goias	60	60	60	60	60	60	60	60
Latin America	Brazil	Anglo American	Catalao, Goias	-	-	-	-	-	-	110	225
Latin America	Brazil	Galvani	Serra do Salitre, MG	-	-	-	-	-	-	100	200
Latin America	Brazil	Vale	Uberaba, MG	435	435	435	435	435	435	435	435
Latin America	Brazil	Vale	Uberaba, MG	350	350	350	350	350	350	350	350
Latin America	Brazil	Vale	Uberaba, MG	180	180	180	180	180	180	180	180
Latin America	Brazil	Yara	Rio Grande, RS	80	80	80	80	80	80	80	80
Middle East				**1,100**	**1,100**	**1,100**	**1,100**	**1,100**	**1,100**	**1,100**	**1,100**
Middle East	Israel	Rotem Amfert Negev (ICL)	Mishor Rotem	600	600	600	600	600	600	600	600
Middle East	Lebanon	Lebanon Chemicals	Selaata	230	230	230	230	230	230	230	230
Middle East	Syria	GECOPHAM	Homs	270	270	270	270	270	270	270	270
South Asia				**110**	**110**	**110**	**110**	**110**	**110**	**110**	**110**
South Asia	Bangladesh	TSP Complex Ltd	Patenga, Chittagong	110	110	110	110	110	110	110	110
East Asia				**2,100**	**2,100**	**2,100**	**2,100**	**2,100**	**2,100**	**2,100**	**2,100**
East Asia	China	Various (Effective Capacity)		2,100	2,100	2,100	2,100	2,100	2,100	2,100	2,100

-Argus Consulting

West Europe

There is no significant output of triple superphosphate in western Europe. Some granulation units are equipped to produce triple superphosphate, for example Borealis, ICL Amsterdam and SECO. These plants have to purchase acid and rock for triple superphosphate manufacture, although SECO used to receive raffinate from Prayon's manufacture of industrial acid grades. Zuidchemie (now a Borealis subsidiary) tolled acid and rock for OCP in the past. Morocco has long had sufficient conversion capacity to make tolling redundant.

The only medium-scale producer of triple superphosphate in western Europe was Agropolychim in Bulgaria. The company operates a small phosphoric acid plant (200,000 t/yr P_2O_5), which is a sink for fatal sulphuric acid. Capacity for triple superphosphate at the site was 260,000 t/yr, with the majority of output exported. The company invested in ammonium phosphate capacity in 2008 and output was planned to swing between DAP, MAP and TSP, although in practise Agropolychim has continued to focus largely on TSP. Production is based on imported Moroccan and Syrian rock, so the future of this operation will remain dependent on the rock pricing policies and the merchant rock availability of these players.

Eastern Europe and central Asia

In recent years Turkey produced about 125,000 t/yr of triple superphosphate, but this rose to 180,000t in 2013 with a swing away from diammonium phosphate production. Gubretas Fabrikalari has a nominal capacity of 185,000 t/yr and also produces NPKs. Other complexes have modified triple superphosphate lines to produce ammonium phosphates and/or NPKs.

The only other producer of triple superphosphate in this region was the Gomel Chemical plant in Belarus. Its original capacity was for 259,000 t/yr P_2O_5 and 200,000 t/yr of triple superphosphate plus smaller volumes of monoammonium phosphate and NP/NPK, but today the emphasis is on monoammonium phosphate (12-54-0) and NPKs. Some "ammoniated superphosphate" is still produced (8-30-0) and a new 600,000 t/yr NPK plant is now on stream.

North America

There is no production of triple superphosphate in North America. A number of ammonium phosphate complexes have produced triple superphosphate in the past and could be switched to its manufacture in future. But there is currently no compelling reason for this to happen.

Latin America

Production of triple superphosphate in Latin America is confined to two countries, Brazil and Mexico:

- Brazil is the major producer in the region with output of around 1mn t in 2013. The major capacities for triple superphosphate as a product in its own right are:

Yara	Rio Grande	80,000 t/yr
Vale (formerly Fosfertil)	Uberaba	965,000 t/yr
Anglo American	Catalao	60,000 t/yr

The figures for Brazil are difficult to interpret because a significant amount of triple superphosphate is produced as run-of-pile and then granulated with other components to make NPKs. Yara produces about 80,000 t/yr (net) at Rio Grande for granulation.

Anglo American's current capacity at the Catalao plant is 200,000 t/yr of high-analysis fertilizers (MAP and TSP). The plant is flexible, but normally the production average is around 30pc TSP and 70pc MAP. About half of the TSP produced is granulated as such, and the other half goes to the production of ammoniated TSP 9-40-0. The company is planning to increase its TSP capacity by another 225,000 t/yr as part of the Goias II project by 2020-21, should the project proceed.

The majority of triple superphosphate produced for sale comes from Vale Uberaba, which operates two 50 t/h TSP plants whose output is then granulated. The company completed a 180,000 t/yr expansion for the Uberaba complex in October 2011. The Salitre project in Minas Gerais will include TSP capacity if it proceeds. But it appears that Vale's interest in the fertilizer sector has diminished over the last couple of years, and all fertilizer projects have been put on hold.

Galvani is currently developing the Serra do Salitre project in minas Gerais, which is expected to be completed by 2020-21 along with new downstream capacities — 1.2mn t/yr of 34pc P_2O_5 rock, 130,000 t/yr of MAP, 410,000 t/yr of SSP and 200,000 t/yr of TSP. The recent acquisition of a 60pc stake by Yara International should bring the financial capacity to develop this project.

- Mexican production has been concentrated at the 250,000 t/yr Innophos (formerly Rhodia) plant at Veracruz. The company's main product line is technical phosphates and triple superphosphate to use up raffinate and acid sludge. Innophos has a long-term phosphate rock contract with OCP, although it is non-exclusive. The Fertinal plant at Lazaro Cardenas has a nominal capacity of 315,000 t/yr of triple superphosphate and SSP or 600,000 t/yr of MAP and DAP.

Africa
There are just two major producers in Africa — OCP in Morocco and GCT in Tunisia:

- OCP has flexibility in production between triple superphosphate and ammonium phosphates, especially at Jorf Lasfar. Official production capacity is 1mn t/yr at Safi and 270,000 t/yr at Jorf. OCP production in 2013 was about 1mn t, mainly from Safi (757,000t) but also from the Jorf Fertilizer Company (JFC), originally Bunge Maroc Phosphore, a 50/50 joint venture with the Bunge group, which has become a wholly-owned subsidiary of the Group since its acquisition of the remaining 50pc stake in 2013. As with Bunge previously, OCP will make a calculation as to whether it is preferable to ship higher concentration 11-52-0 to Brazil rather than 46pc P2O5 triple superphosphate.

  As mentioned earlier in this report, OCP is also investing in the development of the new Safi complex under the Safi Phosphate Hub programme (SPH), through the addition of further integrated fertilizer production units and the transfer of the current assets to a new platform which will enable ammonia imports from the new Safi port currently under construction. The SPH platform is expected to start operations in 2021, with a phosphoric acid capacity of around 2.5mn t P_2O_5 along with associated granulation capacity, including a TSP capacity of 1.5mn t/yr (i.e an additional 500,000t/yr compared to the current Safi site capacity);

- Tunisia operates two plants at M'dhilla, with a combined capacity of 465,000 t/yr, and one plant at Sfax, with a combined capacity of 330,000 t/yr. However, recent reports indicate that GCT has at least partially switched to SSP production in response to market conditions. GCT operates in the same way as OCP — triple superphosphate is relegated to a minor role and production is adjusted according to market circumstances at any specific time.

  Tunisian production has been severely disrupted since the revolution in early 2011, with numerous strikes and sit-ins at the plants. GCT's triple superphosphate production was just 500,000t in 2013. The plant was still only running at 60-70pc capacity in 2014 because of continuing political turmoil and a short supply of phosphate rock, which has been impacted by local strikes. In May 2015, GCT's triple superphosphate production is understood to have been severely disrupted by industrial action in the main rock-producing region of Gafsa. This has halted train supplies of phosphate rock from Gafsa to DAP/TSP production facilities, where stocks of phosphate rock are said to have been exhausted. The phosphoric acid plant at Skhira is also understood to be down. At the time of writing, GCT is building up rock inventory before the plants restart, expected end-June 2015.

  GCT is planning to increase acid capacity in the medium term and when this happens, output will largely be converted into diammonium phosphate with smaller amounts of triple superphosphate. A number of plans and tenders has materialised in recent years that could have an impact on triple superphosphate output:

  - The Sfax complex is limited by urban encroachment. The European Investment Bank (EIB) has granted a loan of €34mn ($45.8mn) to support a scheme to clean up the pollution created at the industrial site of Taparura, largely created by phosphogypsum, and develop the depolluted land for a variety of leisure activities and social housing. The production complex at Sfax is likely to be closed if the programme unfolds under new political circumstances. The port of Sfax will be retained and used for the shipment of phosphate rock. GCT is constructing a new phosphoric acid and TSP plant at M'Dhilla, which is due on line in 2017. These will replace the TSP plant at Sfax which is expected to be closed down by 2016.

  - The Sra Ouertane project would give a foreign joint-venture partner a choice of processed end-product. The potential list includes triple superphosphate, but the project is still at the planning stage

- The Egyptian unit at Abu Zaabal produces only small volumes of sub-specification product. The best quality product has a total P_2O_5 content of 46pc, equating to an available P_2O_5 content of about 42pc. Egypt's triple superphosphate production was reported at only 39,000t in 2013.

Middle East

There are several significant producers in the region:

- The most important is Israel's Rotem (ICL), which produced an impressive 600,000t in 2008 and about 450,000 t/yr in recent years. 2013 production stood at 560,000t. As with single superphosphate, the Israeli industry has developed as a niche exporter of triple superphosphate. ICL has consistently avoided the development of an ammonium phosphates sector, partly because it has no feedstock for the production of ammonia and also because it wished to avoid reliance on suppliers of ammonia in the Mideast Gulf or Black Sea (and the storage of large volumes of ammonia in tanks represents an undesirable risk in the light of the regular conflicts in which Israel has been involved). This was a lesson learnt when the ammonia sphere at the old Delta Suez complex in Egypt was struck by an Israeli rocket during the 1967 conflict and the whole production complex was moved out of range to Talkha. ICL has no plans for any expansions except for slight debottlenecking. ICL in the past produced some triple superphosphate at its Amsterdam Fertilizers complex but this was generally used as a component in PK production. On the other hand, the recent excitement generated by significant gas discoveries in the eastern Mediterranean has already encouraged the Israeli government to consider a new ammonia unit for the country. Given the likely wrangling over the ownership of these gas resources, it is unlikely that such a project will move ahead in the next five to eight years and ICL is expected to continue to focus on triple superphosphate production;

- Lebanon Chemicals has a capacity for 230,000 t/yr of triple superphosphate. In 2013 the company produced about 170,000/t. Traditionally Lebanon Chemical uses Syrian rock but in 2013 it used over 170,000t of OCP rock to top up the limited supply available from Syria (214,000t);

- Syria operates a triple superphosphate plant at Homs that has been rebuilt and produced 180,000 t/yr in the years prior to the political turmoil there. Total production in 2013 is estimated at just 65,000t. Syria would like to process more of its phosphate rock, and project after project has been discussed in the past. But they have generally been thwarted by rock quality considerations and political uncertainty and more recently severe instability. Similar considerations to those in Israel make diversification into ammonium phosphates unlikely. The current political situation suggests that no investment can be expected to be completed in the medium term and production will be limited.

China

China has constructed a triple superphosphate industry as part of its development package for processed phosphates, with production rising to 2.4mn t in 2011 and exports recorded at 1.7mn t. Production and trade fell since then, with the imposition of a high peak-season export duty, and were recorded at 870,000t and 780,000t respectively in 2013. Reported domestic consumption on the other hand is sluggish at around 225,000-285,000t P_2O_5 in 2010-12.

China's triple superphosphate capacity stands at around 2.5mn t/yr, but there is a capacity overlap, not just with NPK but also with single superphosphate that is produced in place of triple superphosphate on occasion. While further small-scale increases in phosphoric acid and ammonium phosphate plant construction are likely, triple superphosphate has reached a plateau. Production is expected to remain at current levels unless tariffs are imposed that inhibit export activity, or unless single superphosphate proves a more economically viable alternative product for the domestic market.

4.1.2. Triple Superphosphate Production

The global market for TSP amounts to 5mn-6.5mn t/yr of product. The lion's share of production is accounted for by a few producers, with around three-quarters of global supply concentrated in China, Brazil, Tunisia, Morocco and Israel.

The following table presents a breakdown of world production since 2000. Chinese figures for the three years to 2007 were revised by the IFA. Earlier figures were higher but clearly included other products that did not belong in the triple superphosphate category:

Table 1-13: Triple Superphosphate Production *'000t P_2O_5*

	2000	2007	2008	2009	2010	2011	2012	2013
World Total	**2,257**	**2,650**	**2,704**	**2,099**	**2,980**	**3,076**	**2,747**	**2,540**
West Europe	220	125	125	57	127	160	154.2	96.2
EECA	12	139	146	150	143	140	146.5	187
North America	519	-	-	-	-	-	-	-
Latin America	354	470	431	387	490	500	540.1	521.4
Africa	685	757	813	565	707	595	690.5	704.8
Middle East	242	545	452	215	413	391	323.8	394.7
South Asia	28	19	21	10	37	28	22.1	36.5
East Asia	197	553	673	628	1,013	1,242	851.4	589.1
Others	0	42	43	88	52	20	17.8	10.1

— IFA; EECA-East Europe/Central Asia

The table below shows producers with an output of over 100,000 t/yr P_2O_5 in the past few years:

Table 1-14: Triple Superphosphate — Major Producers *'000t P_2O_5*

	2000	2006	2007	2008	2009	2010	2011	2012	2013
World Total	**2,450**	**2,456**	**2,650**	**2,704**	**2,099**	**2,980**	**3,076**	**2,747**	**2,540**
Of which									
Brazil	189	326	401	363	358	419	407	448	440
Mexico	140	69	69	68	29	71	94	92	81
Morocco	290	296	365	313	222	359	388	435	451
Tunisia	362	363	369	468	332	342	190	219	233
Israel	115	254	340	276	102	231	211	204	258
Lebanon	15	90	105	100	60	100	100	80	80
Syria	113	113	100	75	53	81	80	40	30
China	189	494	550	670	626	782	1,081	662	400
US	519	100	-	-	-	-	-	-	-
Bulgaria	83	90	105	99	47	102	114	114	93
Sub-total	**2,014**	**2,195**	**2,403**	**2,433**	**1,828**	**2,487**	**2,663**	**2,294**	**2,066**
Others	**437**	**261**	**246**	**271**	**271**	**493**	**413**	**453**	**474**

- IFA

With the exception of Brazil's Anglo American and Galvani/Yara, a possible expansion in Tunisia partly to replace output from Sfax, and the flexibility contained within the units in Jorf Lasfar — none of the major producers of triple superphosphate plans expansions over and above routine debottlenecking. There will be a degree of change in countries with small-scale production, although minor producers account for less than 15pc of total world production of triple superphosphate and their output is declining steadily.

Not all the production of triple superphosphate reported meets the accepted specification of 46pc water soluble P_2O_5. Much of the output in China is based on rock of variable quality and the quality of the triple superphosphate varies accordingly.

4.2. Trade in Triple Superphosphate

There are just four major exporters of triple superphosphate globally. Together they account for 83pc of all export shipments.

Table 1-15: Triple Superphosphate Exports							'000t P_2O_5
	2007	2008	2009	2010	2011	2012	2013
World Total	**1,819**	**1,563**	**1,482**	**1,762**	**1,806**	**1,468**	**1,552**
Major Exporters	**1,526**	**1,295**	**1,267**	**1,432**	**1,511**	**1,186**	**1,295**
Of which							
China	509	452	494	558	797	392	357
Israel	313	276	133	204	213	198	256
Morocco	359	251	249	359	335	391	459
Tunisia	345	308	392	311	166	205	223
Minor exporters	**294**	**268**	**215**	**330**	**295**	**282**	**257**
							— IFA

There has been only one major dynamic within the triple superphosphate business in recent years — the growth of Chinese exports, mainly at the expense of minor participants. In 2011, China's triple superphosphate exports rose to almost 800,000t P_2O_5 (1.7mn t product), an increase of 300,000 t/yr P_2O_5 (650,000t product) over the previous peak in 2007. With triple superphosphate not subject to the stringent peak-season export duties facing ammonium phosphates, phosphate producers were encouraged to switch production. This changed in 2012, with the imposition of a peak season tax and exports fell back to below 400,000t P_2O_5 in 2012 and 2013.

The pattern of imports is perhaps more important for any potential export project. There are only a few significant importers — Brazil, Bangladesh and Iran took 486,000t P_2O_5, 240,000t P_2O_5 and 165,000t P_2O_5 respectively in 2013 — with all other importers taking less than 100,000t P_2O_5.

Table 1-16: Triple Superphosphate Imports								'000t P_2O_5
	2000	2007	2008	2009	2010	2011	2012	2013
World Total	**1,614**	**1,809**	**1,562**	**1,481**	**1,761**	**1,805**	**1,466**	**1,551**
West Europe	**552**	**268**	**139**	**184**	**235**	**195**	**160**	**205**
E Europe/ Central Asia	**14**	**11**	**4**	**4**	**-**	**3**	**4**	**10**
Africa	**5**	**32**	**46**	**66**	**73**	**44**	**48**	**39**
North America	**3**	**106**	**79**	**18**	**69**	**111**	**79**	**74**
Canada	3	1	-	-	-	-	-	-
US	-	106	79	18	69	111	79	74
Latin America	**458**	**750**	**519**	**488**	**583**	**630**	**637**	**621**
Brazil	275	579	406	420	454	504	469	486
Argentina	31	90	16	16	43	51	31	31
Mexico	1	-	-	-	-	2	-	-
Other	151	81	98	52	86	74	137	104
Middle East	**236**	**322**	**230**	**276**	**332**	**133**	**65**	**165**
Iran	228	321	230	259	327	133	65	165
Other	8	1	0	17	5	0	0	0
South Asia	**155**	**154**	**372**	**327**	**314**	**440**	**303**	**278**
Bangladesh	137	101	240	272	199	310	264	240
India	-	-	84	43	52	74	1	-
Sri Lanka	17	43	35	12	58	56	38	36
Pakistan	-	10	13	-	5	0	1	2
Southeast Asia	**76**	**95**	**78**	**100**	**114**	**173**	**112**	**101**
East Asia	**24**	**19**	**24**	**12**	**32**	**36**	**25**	**26**
Oceania	**92**	**52**	**54**	**5**	**12**	**27**	**24**	**6**
Australia	80	43	49	4	9	24	22	4
New Zealand	12	9	5	1	3	3	2	2
Other	**-**	**1**	**0**	**1**	**0**	**-**	**8**	**28**
								IFA

The following trade matrix highlights the main trade flows in 2013. These are described in more detail below.

Table 1-17: Triple Superphosphate Trade Matrix, 2013 *'000t P_2O_5*

	Exporter							
Importer	**Bulgaria**	**Mexico**	**Morocco**	**Tunisia**	**Israel**	**China**	**Other**	**Total**
World Total	**87**	**74**	**459**	**223**	**256**	**357**	**96**	**1,552**
West Europe	**38**	**-**	**41**	**23**	**92**	**-**	**11**	**205**
France	-	-	18	6	33	-	1	58
UK	-	-	18	4	31	-	2	55
Other western Europe	38	-	5	13	28	-	8	92
EE/CA	**10**	**-**	**-**	**-**	**-**	**-**	**0**	**10**
Africa	**-**	**-**	**22**	**-**	**6**	**1**	**10**	**39**
North America	**10**	**-**	**21**	**-**	**42**	**-**	**1**	**74**
Latin America	**0.5**	**74**	**281**	**64**	**110**	**59**	**39**	**621**
Brazil	-	-	260	59	105	37	20	486
Other Latin America	0.5	74	21	5	5	22	8	135
Middle East	**28**	**-**	**-**	**-**	**-**	**137**	**-**	**165**
Iran	28	-	-	-	-	137	-	65
Other	-	-	-	-	-	0	-	0
South Asia	**-**	**-**	**87**	**133**	**-**	**38**	**34**	**278**
Bangladesh	-	-	87	133	-	-	20	240
Other south Asia	-	-	-	-	-	38	-	38
SE Asia	**-**	**-**	**-**	**-**	**-**	**101**	**-**	**101**
Indonesia	-	-	-	-	-	80	-	80
Other southeast Asia	-	-	-	-	-	21	-	21
East Asia	**-**	**-**	**3**	**-**	**6**	**10**	**7**	**26**
Oceania	**-**	**-**	**1**	**-**	**-**	**4**	**1**	**6**
Unspecified	**-**	**-**	**-**	**2**	**-**	**-**	**26**	**28**

— IFA

Europe

Triple superphosphate is compatible with ammonium nitrate products in blending, so there is moderate demand in European countries with significant blending industries. Blending in France and the UK is on a larger scale and undertaken at a wholesale rather than a retail level. The same applies to some of the larger merchants in Italy. The availability of nitrogen from the domestic industry can be a significant factor in determining which form P_2O_5 takes. In countries that are self-sufficient or have a surplus of nitrogen, there may be an incentive to purchase P_2O_5 in straight form rather than combined with nitrogen. The main suppliers to Europe are Morocco, Tunisia and Israel.

Table 1-18: European Triple Superphosphate Imports							'000t P_2O_5
	2007	2008	2009	2010	2011	2012	2013
Total	**269.1**	**139.7**	**183.3**	**234.9**	**194.5**	**159.7**	**205.6**
Of which							
Belgium	39.7	19.2	20.8	31.7	31.7	16.1	25.4
France	69.1	44.2	64.2	61.7	44.4	44.1	58
Italy	30.3	10.7	9.1	17.4	21.3	18.5	13.4
Netherlands	2.2	1.2	0.5	12.9	28.2	11.8	19.4
Spain	22.6	2.8	3.3	-	0.9	1.9	2.5
UK	67	41.7	60.9	72.9	37.8	41.3	54.9
Sub-total	**228.7**	**118.6**	**158.8**	**196.6**	**164.3**	**133.7**	**173.6**
Others	**40.4**	**21.1**	**24.5**	**38.3**	**30.2**	**26**	**32**
							— IFA

There is virtually no demand in central or eastern Europe where there is little history of producing or using triple superphosphate.

North America

As the US phosphate rock industry declines, choices have been made in respect of downstream processing. This allows the industry to focus on what makes best economic sense, in terms of product lines and export versus domestic market activity. The decision by Mosaic to cease triple superphosphate production at the last remaining US triple superphosphate plant at South Pierce, Florida, created a new import market. Ignoring 2008, shipments to the US have been in a range of 70,000-110,000 t/yr P_2O_5 in 2007-13 compared with around 20,000 t/yr previously. In 2013, Israel was the main supplier, accounting for more than half of imports, followed by Morocco.

Latin America

The largest importing region is Latin America, where four countries account for practically all trade:

Table 1-19: Latin American Triple Superphosphate Imports							'000t P_2O_5
	2007	2008	2009	2010	2011	2012	2013
Total	**758.5**	**519.4**	**488.1**	**582.8**	**630.4**	**637.3**	**621.3**
Of which							
Argentina	94.5	15.5	16.1	42.6	51.1	30.7	31.4
Brazil	579.1	405.5	420.3	454.2	504.2	469.2	486
Chile	56.9	42.6	29	60.9	49.8	79	26.2
Uruguay	15.3	3.2	6.6	11.5	7.2	16.5	13.7
Sub-total	**745.8**	**466.8**	**472**	**569.2**	**612.3**	**595.4**	**557.3**
Others	**12.7**	**52.6**	**16.1**	**13.6**	**18.1**	**41.9**	**64**
							— IFA

The surging soybean market has stimulated demand for triple superphosphate in Brazil and northern Argentina. Imports increased sharply in 2007 with the global commodities boom, although they have since moderated slightly. Brazil's triple superphosphate major import sources in 2013 were:

Israel	105,000t P_2O_5
China	37,000t P_2O_5
Morocco	260,000t P_2O_5
Tunisia	59,000t P_2O_5

Middle East

Iran is the only significant importer in the Middle East, taking 327,000t P_2O_5 in 2010. Imports have since fallen to 165,000t P_2O_5 in 2013, but this is still up by 100,000t P_2O_5 from 2012 levels. In 2013, China was the main supplier, accounting for 83pc of imports, along with Bulgaria. The reasons behind Iran's choice of triple superphosphate as a major phosphate import source are opaque. The only phosphoric acid plant in Iran (Razi) produces ammonium phosphates. Imports were recorded at 144,000t P_2O_5 in the first nine months of 2014.

South Asia

Bangladesh has a long history of superphosphate importation to top up local manufacture. In recent years, as single superphosphate became more expensive to import and less available, trade has moved in favour of triple superphosphate. The decision to build two diammonium phosphate plants based on imported phosphoric acid had to do with pressure by aid donors looking for construction contracts rather than any agronomic change of heart. Bangladesh imported 200,000-300,000 t/yr P_2O_5 in 2010-13. Sri Lanka is the other regular importer, receiving 12,000-56,000t P_2O_5 in 2007-13. India purchased for the first time in 2008 (84,000t P_2O_5), with smaller volumes in 2009-11 and virtually nothing in 2012-13, reflecting the country's cost and subsidy-driven import policy. China shipped 210,500t P_2O_5 to south Asia in 2011 and less than one fifth of this volume in 2013, following the imposition of export duties in line with those prevailing on ammonium phosphates.

Southeast and east Asia

Triple superphosphate imports into the region have fluctuated in the 100,000-175,000t P_2O_5 range in recent years, practically all of which originates from China. Indonesia is the largest importer, taking 80,000-145,000 t/yr P_2O_5. The Indonesian import strategy reflects the availability of subsidised nitrogen of domestic origin, which makes importing nitrogen unattractive. Imports of P_2O_5 to Indonesia mainly take the form of phosphate rock, phosphoric acid, single and triple superphosphate. As previously mentioned, both Gresik and Kaltim have projects to take Jordanian rock for new phosphoric acid units.

Oceania

The region imported around 50,000-60,000t P_2O_5 of TSP in 2007 and 2008 before collapsing to less than 10,000 t/yr P_2O_5 in 2009 and 2010, with virtually no recovery since then.

4.3. The Outlook for Triple Superphosphate

Production and delivery figures give a better picture of triple superphosphate demand than consumption statistics. Like ammonium phosphates, a large proportion of material is used in the manufacture of NPK blends and so does not show up in end-use statistics. It is quite evident from both production and trade statistics that the triple superphosphate business is at best static. While it may have suited vertically integrated phosphate rock manufacturers to promote triple superphosphate and merchant phosphoric acid, the market took a different view of the relative merits of these two products, relative to ammonium phosphates.

The enormous success of ammonium phosphates and the relative lack of success of triple superphosphate can be attributed to a few factors that remain as valid today as they did 30 years ago:

- The nutrient content of triple superphosphate is about 70pc lower than that of high-grade ammonium phosphate, which means that more costs are accrued in every handling manoeuvre — from recovery and bulk storage at plant to application in the field. Just in respect of ocean freight, the cost of shipping 1t of diammonium phosphate can be compared with that of 1t of triple superphosphate plus 0.4t of urea. Only in countries producing their own nitrogen and supplying it to farmers at a subsidy, or where a crop needs no nitrogen, is it easy to forego this advantage;

- Traditionally, there was always a cost advantage in the unit nutrient price of the nitrogen contained in diammonium phosphate against that in urea, which is only partially the result of freight saving. For an ammonium phosphates producer, ammonia is a manufacturing component the cost of which has to be covered in the selling price of the ammonium phosphate. As the sole ingredient in vertically integrated urea production, the ammonia manufacturer is looking to recover all the added value of processing. This different attitude to the value of nitrogen has tended to result in the nitrogen component of ammonium phosphates offering a cheaper alternative to the purchase of imported straight nitrogen fertilizers, although the major vertically integrated companies are now more sophisticated;

- Over the past 30 years, the production of chemically combined NPK products has become less economically attractive. Outside China there has been little construction of major new NPK facilities in recent years. Blending offered a cheaper and more flexible route to the production of standard, multi-nutrient fertilizers in locations where farming was sufficiently modern and large scale. Over the same period, urea has come to dominate the nitrogen market — it now accounts for over 50pc of fertilizer nitrogen. Superphosphates react with urea in blends and the two components cannot easily be used together. Only when a PK compound is required does triple superphosphate become a generally useful blend component. Countries with major modern agricultural sectors, such as Brazil, now apply 85pc of their fertilizer as compounds (mainly blended). In the case of western Europe, the decline in ammonium nitrate consumption and growth in urea is negative for triple superphosphate because of the compatibility issue;

- Rapidly growing demand for potash is changing this situation somewhat in Asia, where landholdings are generally small. In many countries, urea and diammonium phosphate have dominated fertilizer consumption over many years, but with recognition of the need for regular potash applications, there is new hope for chemically-combined or steam-granulated NPKs. Compaction and steam granulation units are being built in countries such as Indonesia and Malaysia. NPKs have one distinct advantage over blends in many Asian countries, namely they are less prone to dilution or adulteration by unscrupulous suppliers or merchants. Standard formulations for various crops and regions can be produced and bagged in small packages suited to small farming. Where ammonium sulphate is used in compaction or granulation, triple superphosphate becomes an option for supplying the P_2O_5 component;

- Some regard triple superphosphate as a modern version of single superphosphate — a high-analysis version of a trusted but low-analysis product. This has generally not proven to be the market view, since triple superphosphate does not have the sulphur content that makes single superphosphate attractive in countries such as Brazil, Australia and New Zealand. In Australia, triple superphosphate has not been successful as a replacement for single superphosphate — the triple superphosphate imported into Australia has mainly been used in the manufacture of a sulphur-coated product that was meant to compete with single superphosphate but has failed to become established. The acceptance of significant volumes of triple superphosphate in Brazil and Argentina reflects the nutrient requirements of soybean which fixes its own nitrogen. Even in China, triple superphosphate has failed to make an impression on the domestic market. With high tariffs making exports less attractive, some triple superphosphate plants in China switch between triple and single superphosphate, which is readily accepted domestically. This also allows better utilisation of complexes at a time when sulphur is expensive and in tight supply.

The lack of investment in triple superphosphate capacity, with the exception of Brazil, reinforces the view that it does not have a dynamic future. Production has been in decline since the 1980s and trade is static. There are no indications in the market that a new role will be found for triple superphosphate that will allow it to compete with ammonium phosphates.

4.4. Main Conclusions

The main conclusions are as follows:

- Like its low-analysis counterpart, triple superphosphate has failed to develop into a major force on the international market. Production and trade have declined since the 1980s. There are no firm expansion plans outside revamps and expansions in Brazil, a replacement plant proposed in Tunisia and the joint-venture complex in Morocco designed to produce monoammonium phosphate and/or triple superphosphate;

- The trend in Asia towards steam granulation and compaction is unlikely to favour triple superphosphate significantly, as urea still tends to be the major component of NPKs produced in this way and the two components cannot easily be used together. Only where ammonium sulphate is available will triple superphosphate have a market opportunity, but increasingly in competition with unacidulated phosphate rock;

- The main development of production capacity will be in Brazil, or for the Brazilian market. The exception may be Algeria, although a phosphate investment in Algeria appears to be some way off;

- Triple superphosphate and merchant phosphoric acid may be grouped together as the failed products of the revolution in vertically integrated production. Both have lost out to ammonium phosphates — whether as direct application fertilizers, blend components or, increasingly, intermediates in the steam granulation or compaction of NPKs.

Chapter 5: Single Superphosphate

5.1. The Single Superphosphate Industry

Single superphosphate was once the main mineral source of P_2O_5 fertilizer. It is a relatively low-tech process that involves the spraying of slightly-diluted sulphuric acid on phosphate rock. In the 100 years or so before World War 2, sulphuric acid was regarded as the workhorse of industry, and was used in many major industrial processes. It was also a by-product of the metals smelting industry, as it is to this day. Before World War 2, it was the norm to transport raw materials such as metal ores or phosphate rock to the developed world, where they were processed into final products. At that time, there were still significant deposits of ores and coal in regions such as Europe — the residue of the raw materials that had sparked the industrial revolution. The production of smelter acid at small metals operations throughout Europe and North America resulted in a disposal problem with the fatal sulphuric acid generated, and this was most easily solved by importing phosphate rock to absorb the acid and produce fertilizer for local agriculture.

This set-up has radically changed over the past 50 years or so. Metal ore and phosphate rock processing has generally moved closer to the mining operation — a great deal of which is in the developing world. Simultaneously the development of phosphoric acid-based fertilizer technology has led to the construction of high-analysis phosphate fertilizer plants. Initially, small-scale phosphoric acid plants were constructed at the sites of small-scale single superphosphate operations in Europe, Japan and North America, but these were closed during the course of the late 20th century for a number of reasons:

- Lack of economic scale;
- Closure of a lot of small-scale smelting capacity providing fatal sulphuric acid;
- Problems of phosphogypsum disposal;
- Growing cost of importing phosphate rock;
- Development of large-scale vertically integrated industries in North Africa, Middle East, the US and in a number of smaller rock-producing countries such as Israel, South Africa and Russia.

The establishment of single superphosphate in parts of the developing world followed the same pattern as in the developed world — but took place mainly after World War 2. Where sulphuric acid was available from other industries, or where brimstone was available for conversion into acid, rock was mined or imported to serve the requirements of local agriculture — or at least the cash crop sector. The majority of these single superphosphate units closed as modern high-analysis fertilizers became available. This includes most of the units in the big rock-producing countries such as Morocco, which have switched to phosphoric acid-based products.

It is against this historical background that the current shape of the phosphate business as a whole, and the single superphosphate sector in particular, must be understood. Where market economies have developed or governments have withdrawn from industrial involvement, single superphosphate industries have tended to wither. Only in a few specific circumstances have they survived.

But there are signs that single superphosphate manufacture is growing and will continue to do so in a number of regions of the world, with renewed momentum in India in particular. In respect of rock feed, this renewed interest has a number of causes:

- The high cost of P_2O_5 is encouraging consideration of the exploitation of small deposits of rock, even of lower grade. If the rock is to be acidulated, the only real option in terms of scale, processing options and cost is single superphosphate. In many cases, poor quality rock is simply unsuited to phosphoric acid production but will produce a single superphosphate with 15-18pc available P_2O_5. Local availability of lower-analysis product at a lower price per bag is seen as a way to move agriculture forward in poor countries. The poorer the farmer the less important the absolute P_2O_5 content and water solubility;

- The sulphur content of single superphosphate has always been appreciated in certain agricultures and soil conditions. As sulphur deficiency spreads, alternative means of supplying fertilizer sulphur will be considered and single superphosphate will figure in such considerations;

- The importance of calcium is being recognised in terms of pH control and the release of other nutrients held in the soil to plants — especially in the African context — and plants' requirement for calcium. Single superphosphate may have a role to play in this regard.

The table below presents IFA data on production, imports and exports of single superphosphate from 1990 to 2012, with some minor modifications to the production statistics where data is missing. The following table presents consumption figures for single superphosphate by key country/region using reported IFA figures, along with estimates of apparent consumption where IFA figures have been subsumed into NPK products (such as Australia and New Zealand). While the figures are incomplete, they do provide a reasonable picture of the shape of the single superphosphate sector, and how it has developed over the past 20 years. The figures are presented in P_2O_5 and there is a wide variance in respect of nutrient content, which may lead to an overestimation of the contribution of single superphosphate to the phosphates balance.

In developed markets where there is strong demand for single superphosphate as a carrier of phosphate and sulphur, higher grade superphosphate products can be seen. For example, Anglo American in Brazil offers:

- Granular or coarse single superphosphate with a 21pcP_2O_5 content;
- Ammoniated single superphosphate (03-17-0)

Wesfarmers in Australia offers:

- Superphosphate 20-21pc P_2O_5 (9.1pc P) 25pc SO_3, 28pc CaO;
- Superphosphate with added copper and zinc
- Superphosphate with added copper, zinc and molybdenum

Incitec Pivot in Australia offers a 20pc P_2O_5 single superphosphate with or without molybdenum additive. It is important to note that the P_2O_5 content of the product for sale refers to plant-available phosphate — water and citric acid soluble. The actual chemical specification of the IPL single superphosphate is as follows:

- Water soluble 8pc P (19pc P_2O_5)
- Citric acid-soluble 0.6pc P (1.4pc P_2O_5)
- Citric acid-insoluble 0.2pc P (0.45pc P_2O_5)

The product is generally referred to as 20pc P_2O_5 single superphosphate, as available phosphate is the only statutory measure.

In New Zealand, Ravensdown Fertilizers produces a 20.6pc total P_2O_5 single superphosphate sold as a 20pc P_2O_5 product.

The production of these high-grade single superphosphate products requires a rock feed with at least 34pc P_2O_5. Generally speaking this has been achieved in recent years by blending Boucraa rock from Morocco with other cheaper rocks. Far from a disposal product, high-grade single superphosphate is expensive to make and valued for all the plant nutrients it contains.

Chinese companies offer a 20pc P_2O_5 single superphosphate of which 18pc is stated to be soluble. Free acid in the better specification products is maximum 5.5pc and moisture maximum 5pc. As with most P_2O_5 products in China, there appear to be no regulatory norms for describing products or consistency of specification. High-analysis single superphosphate with 12pc moisture content is for sale. Most of the sales advertisements make no mention of the P_2O_5 content of the product. Where it is mentioned the main range is 14-18pc P_2O_5. At the bottom end a 9pc P_2O_5 single superphosphate is offered and a boronated single superphosphate with 12.5pc P_2O_5.

For other countries that essentially produce single superphosphate as a historical legacy and in order to avoid expenditure on imports, for example, India, Vietnam and Egypt, single superphosphate tends to have a P_2O_5 content in the 13-18pc range but within this range other factors vary significantly. These include heavy metals content, humidity, solubility and physical characteristics.

Table 1-20: SSP Production, 1990-2012									'000t P_2O_5
	1990	2000	2005	2007	2008	2009	2010	2011	2012
World Total	**5,464**	**6,361**	**6,340**	**6,022**	**5,328**	**5,456**	**5,306**	**5,270**	**5,046**
West Europe	**620**	**174**	**96**	**158**	**142**	**49**	**91**	**120**	**132**
Czech Republic	58	-	-	-	-	-	-	-	-
France	-	52	-	-	-	-	-	-	-
Germany	71	-	-	2	2	3	3	2	3
Hungary	77	25	-	-	-	-	-	-	-
Italy	53	30	30	23	20	4	3	3	5
Poland	192	17	66	116	107	28	70	80	85
Spain	99	14	-	16	13	14	15	35	39
Others	70	35	-	1	-	-	-	-	-
EECA	**48**	**60**	**14**	**21**	**30**	**21**	**25**	**47**	**34**
Africa	**215**	**198**	**290**	**249**	**245**	**218**	**225**	**321**	**455**
Egypt	137	162	263	248	244	214	220	316	450
Morocco	17	9	-	-	-	-	-	-	-
South Africa	23	-	-	-	-	-	-	-	-
Others	38	27	27	1	1	4	5	5	5
North America	**55**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Latin America	**418**	**759**	**869**	**1,133**	**962**	**860**	**1,048**	**1,148**	**1,059**
Argentina	-	-	-	44	10	12	72	90	77
Brazil	359	734	849	1,052	928	830	958	1,047	968
Mexico	52	9	10	16	12	8	10	8	10
Others	8	15	10	21	12	10	8	3	4
Middle East	**-**	**67**	**-**	**-**	**2**	**3**	**6**	**-**	**-**
South Asia	**615**	**487**	**461**	**394**	**428**	**524**	**635**	**728**	**724**
Bangladesh	-	19	20	10	5	2	5	7	-
India	584	439	441	359	405	495	594	692	706
Pakistan	31	29	-	25	18	27	36	30	18
SE & E Asia	**3,089**	**3,962**	**4,191**	**3,543**	**3,100**	**3,423**	**2,802**	**2,406**	**2,153**
China	2,829	3,773	4,001	3,350	2,921	3,243	2,600	2,200	1,950
Japan	61	36	30	23	16	14	12	12	3
Korea DPR	137	20	-	-	-	-	-	-	-
Vietnam	54	132	160	170	163	166	170	175	180
Others	8	1	-	-	-	-	20	19	20
Oceania	**406**	**656**	**420**	**526**	**420**	**357**	**474**	**499**	**489**
Australia	239	273	200	297	250	199	244	250	267
New Zealand	168	383	220	229	170	158	230	249	222

— IFA/Argus Consulting; EECA- East Europe/Central Asia

Table 1-21: SSP Exports, 1990-2012									'000t P_2O_5
	1990	2000	2005	2007	2008	2009	2010	2011	2012
World Total	**47**	**156**	**79**	**158**	**150**	**87**	**126**	**212**	**260**
West Europe	**28**	**41**	**1**	**8**	**9**	**7**	**12**	**16**	**19**
EECA	**-**	**10**	**4**	**-**	**-**	**-**	**-**	**0**	**0**
Africa	**0**	**23**	**31**	**65**	**71**	**33**	**35**	**45**	**80**
Egypt	-	11	30	64	70	33	35	45	80
Others	0	12	1	1	1	-	-	-	-
N America	**8**	**5**	**-**	**1**	**1**	**1**	**1**	**-**	**-**
Latin America	**10**	**14**	**26**	**14**	**3**	**9**	**14**	**17**	**5**
Brazil	-	0	26	10	-	7	10	10	2
Mexico	-	8	-	4	3	-	-	-	-
Others	10	6	-	-	-	2	4	7	3
Middle East	**-**	**64**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
South Asia	**-**	**-**	**1**	**-**	**-**	**-**	**-**	**-**	**-**
SE & E Asia	**1**	**-**	**17**	**43**	**51**	**17**	**42**	**111**	**131**
China	-	-	17	43	50	16	41	110	130
Others	1	-	-	0	1	1	1	1	1
Oceania	**-**	**-**	**-**	**28**	**15**	**20**	**22**	**23**	**25**
Australia	-	-	-	28	15	20	22	23	25

— IFA; EECA- East Europe/Central Asia

Table 1-22: SSP Imports, 1990-2012									'000t P_2O_5
	1990	2000	2005	2007	2008	2009	2010	2011	2012
World Total	**210**	**168**	**127**	**233**	**172**	**101**	**174**	**260**	**296**
West Europe	**93**	**65**	**5**	**64**	**64**	**23**	**63**	**58**	**50**
France	-	18	-	21	28	10	25	22	24
Hungary	63	2	3	5	3	4	4	1	1
Italy	-	21	-	24	18	2	7	5	3
Spain	6	21	-	8	5	2	3	6	4
Others	25	3	2	6	10	5	25	24	18
EECA	**-**	**-**	**-**	**1**	**1**	**0**	**-**	**1**	**1**
Africa	**37**	**11**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
North America	**3**	**-**	**-**	**6**	**0**	**1**	**0**	**-**	**-**
Latin America	**77**	**78**	**68**	**117**	**75**	**57**	**93**	**163**	**140**
Argentina	-	11	41	45	15	12	30	40	5
Brazil	14	67	27	73	60	45	63	122	135
Others	63	-	-	-	-	-	1	1	-
Middle East	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**8**	**8**
South Asia	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Bangladesh	-	-	-	-	-	-	-	-	-
SE&E Asia	**-**	**4**	**54**	**31**	**22**	**18**	**16**	**29**	**96**
Indonesia	-	-	46	23	16	15	16	29	96
Others	-	4	8	9	6	3	0	-	-
Oceania	**-**	**11**	**-**	**14**	**10**	**1**	**1**	**1**	**1**
Australia	-	5	-	14	10	1	1	1	1
New Zealand	-	6	-	-	-	-	-	-	-

— IFA; EECA- East Europe/Central Asia

Table 1-23: SSP Consumption, 1990-2012									'000t P_2O_5
	1990	2000	2005	2007	2008	2009	2010	2011	2012
World Total	**5,445**	**6,184**	**6,166**	**5,998**	**5,301**	**5,328**	**6,180**	**5,040**	**4,765**
West Europe	**587**	**117**	**70**	**162**	**141**	**60**	**154**	**150**	**149**
Czech Republic	88	-	-	-	-	-	-	-	-
France	-	-	-	12	10	19	25	19	25
Germany	70	-	-	-	-	-	-	-	-
Hungary	67	8	3	3	3	4	4	1	1
Italy	69	50	-	10	6	10	27	5	7
Poland	184	18	65	116	107	24	65	80	85
Spain	44	26	-	18	11	1	11	19	15
Others	64	15	2	4	4	2	22	25	16
EECA	**27**	**21**	**10**	**8**	**13**	**2**	**3**	**23**	**3**
Africa	**241**	**172**	**175**	**156**	**173**	**136**	**151**	**142**	**158**
Egypt	154	151	174	156	172	134	149	140	153
Morocco	17	8	-	-	-	-	-	-	-
South Africa	23	-	-	-	-	-	-	-	-
Others	47	12	1	-	1	2	2	2	5
North America	**5**	**4**	**0**	**-**	**-**	**-**	**-**	**-**	**-**
Latin America	**492**	**822**	**898**	**1,237**	**1,042**	**913**	**1,114**	**1,291**	**1,193**
Argentina	-	10	41	89	35	67	85	120	73
Brazil	373	801	850	1,115	988	828	1,011	1,159	1,106
Mexico	50	2	-	12	9	8	10	8	10
Others	70	9	7	21	10	10	9	4	4
Middle East	**0**	**3**	**-**	**-**	**2**	**3**	**-**	**-**	**-**
South Asia	**606**	**510**	**441**	**401**	**449**	**455**	**657**	**793**	**671**
Bangladesh	-	22	-	10	5	2	5	7	-
India	575	458	441	366	419	424	612	760	645
Pakistan	31	31	-	25	25	28	40	26	26
SE & E Asia	**3,081**	**3,967**	**4,152**	**3,523**	**3,066**	**3,421**	**3,641**	**2,134**	**2,118**
China	2,829	3,773	3,984	3,305	2,871	3,227	3,415	1,900	1,820
Japan	61	38	-	26	17	14	12	12	3
South Korea	137	20	-	-	-	-	-	-	-
Vietnam	54	132	160	169	162	165	169	174	179
Others	0.2	4	8	23	16	15	45	48	116
Oceania	**406**	**570**	**420**	**512**	**415**	**338**	**453**	**499**	**465**
Australia	239	225	200	284	245	180	223	228	243
New Zealand	168	345	220	229	170	158	230	271	222

— IFA/Argus Consulting; EECA- East Europe/Central Asia

There are two major producer-consumers of single superphosphate that have maintained an industry not for agronomic reasons or consumer preference, but for reasons of national economic policy — China and India.

China

The Chinese industry was a late developer. The famines of the 1950s persuaded the Maoist government of the necessity of modernising industry and agriculture after years of turning its back on external technological developments. The only easily available technology was that for single superphosphate and fused magnesium phosphate. As China had rock, coal and pyrites, the raw materials were in place to construct a large industry, although this rapidly became outdated. Not until the Cultural Revolution and its aftermath did China change direction and embrace modern processes. The reasons for retaining a large single superphosphate sector today are similar to India's. One of the most important factors for the retention of some of the old industry is the size of the market — both geographically and in volume terms. If timely delivery of fertilizer is to be achieved in all areas of the country, the existence of inland plants is essential. If all deliveries were to be imported on a seasonal basis, the port and inland rail infrastructure would be unable to cope.

China was, until recently, a major importer of P_2O_5 values, mainly in the form of ammonium phosphates and NPKs. Over the past 10-15 years, a programme of mine building and plant construction for ammonium phosphates and NPKs has unfolded and has achieved its objective of moving China to a position of self-sufficiency in P_2O_5 and beyond that to a net surplus. This development has been supported by China's large but fragmented reserves of phosphatic mineralisation, which have made it the largest producer of phosphate rock in the world. The rapid development of high-analysis phosphate and compound fertilizer production does not necessarily preclude the continued operation of old, low-analysis fertilizer operations — such as fused magnesium phosphate and various low-analysis superphosphate products. If such operations fail — as has been the case with some old, small-scale ammonium chloride and ammonium bicarbonate plants — this will be accepted, as the bankruptcy of some of the modern phosphoric acid-based plants has been accepted.

China is likely to continue producing single superphosphate, although in declining volumes, for many more years, especially at smaller and/or more remote phosphate rock mining areas that are unsuited to the development of larger-scale phosphoric acid manufacture. Inevitably, higher-analysis products will gradually erode the market share of single superphosphate, as the continuing surge of new processing capacity is commissioned and pressure is put on rock availability. The likelihood is that the low-analysis industries — mainly single superphosphate and fused magnesium phosphate — will be concentrated in marginal rock production areas, where phosphate rock contains impurities that make it unsuitable for phosphoric acid production, or in remote areas that retain a degree of local self-sufficiency.

From a global perspective and until recently, developments in China had no impact on the single superphosphate sector since the product was neither exported nor imported in significant quantities. This has changed with the export duty on high-analysis phosphate fertilizers spurring a modest switch to unregulated single superphosphate. However, in 2014, China introduced a flat 5pc export tax on single superphosphate and triple superphosphate, which was renewed in 2015.

Table 1-24: Chinese SSP Exports						'000t P_2O_5*
	2009	2010	2011	2012	2013	2014
World	**16**	**40.9**	**124.6**	**143.1**	**108.7**	**134.9**
Brazil	0	0	52.7	39.4	46.5	13.3
Indonesia	11.9	3.6	44.5	82.6	26.5	70.4
Australia	0	31.7	12.1	8.9	15.2	36.9
Myanmar	0	0.2	4.3	2.3	0.6	0.1
Japan	2	2.2	3.6	3.4	2.3	3
Nigeria	0	0	3.6	0	0	0
Other	2.2	3.2	3.8	6.5	17.6	11.2
*assumes 18pc P_2O_5						— GTIS

India

Single superphosphate continues to play a modest role in Indian phosphate fertilizer supply, and makes an important contribution to the provision of fertilizer sulphur. Nevertheless, the reasons for its use tend to be connected with the economics of P_2O_5 supply rather than fertilizer sulphur. Production of single superphosphate increased significantly in 2009-12, and then slowed. Production stood at 4.2mn t in 2013-14, down by 6pc compared with the previous year because of high inventories and liquidity issues caused by the delay in subsidy payment. Its share to total production of P_2O_5 was around 17pc. In terms of consumption, India used 6.7mn t P_2O_5 in 2012-13 of which single superphosphate contributed only 11pc. This compares with about 30pc in Brazil, 16pc in China and over 90pc in Egypt. The industry claims to have been disadvantaged over many years by the subsidy system, which resulted in a 49pc capacity utilisation rate in 2013-14, down from 58pc in 2012-13. However, the size of the import and subsidy bills for P_2O_5, combined with growing awareness of the need for fertilizer sulphur is encouraging a degree of growth in the single superphosphate sector.

The following summary of the structure of the single superphosphate industry in India and the supply of fertilizer sulphur will help to measure its future impact:

Table 1-25: Regional Shares of Production and Consumption in India (Apr 2013-Mar 2014)		pc
Region	**SSP Production**	**SSP Consumption**
West	75	69
East	11	12
South	9	9
North	6	10
		— FAI

Production is well spread across India, with a predominance in the west. As the product is low analysis in terms of P_2O_5, it generally remains within the area of production. Given the logistical task of moving imported product to the country's interior in good time for application, the inland location of much production is an additional benefit to the saving of foreign exchange. Single superphosphate is mainly used by medium and small-scale farmers where its low cost per unit P_2O_5 plus its sulphur, calcium and trace element content make it a valuable contribution to balanced fertilization.

Rajasthan accounts for the majority of rock produced in India, with most of the remainder produced in Madhya Pradesh. The rock contains significant impurities to the extent that it is not suited to the production of phosphoric acid, and so single superphosphate is the only viable option, apart from small volumes sold for direct application.

As with the fertilizer sector as a whole — the future expansion of the single superphosphate industry depends on government policy. To stimulate investment in production a number of incentives have been granted to the fertilizer sector:

- Withholding tax on interest payments on external commercial loans has been reduced to 5pc for the next three years from 20pc;
- Investment-linked deduction of capital expenditure will increase to 150pc for the next three years from 100pc;
- Customs duty for imports of equipment will be reduced to zero for three years from 5pc.

There are 79 single superphosphate units operational in India with a total recorded capacity of 9.7mn t/yr. But many are small and very old and only eight operate at a utilization rate above 80pc. The top 10 producers now account for 70pc of production and are the most likely source of increased utilisation.

In addition to scope for increasing output from existing capacity, some new units are being added or planned:

- Coromandel plans a 250,000 t/yr single superphosphate unit in Punjab for 2015;
- Chambal completed a 180,000 t/yr single superphosphate unit at Gadepan in Rajasthan in mid-2012 and plans a 500,000 t/yr single superphosphate plant at Dahej in Gujarat for 2015-16;
- Tata Chemicals has expanded its capacity to 160,000 t/yr at its Haldia plant;
- Liberty Phosphate is India's largest producer of single superphosphate. Its production unit at Udaipur in Rajasthan has a nominal capacity of 264,000 t/yr. It recently commissioned a 132,000 t/yr plant at its Raebareli site in Uttar Pradesh. Plans are in hand to expand the capacity of its Kota, Rajasthan plant to 198,000 t/yr from 132,000 t/yr and its Pali, Maharashtra plant to 132,000 t/yr from 66,000 t/yr. The company's capacity at the end of this programme will be in excess of 900,000 t/yr;
- Paradeep Phosphates, a joint venture with OCP, is looking to construct a 500,000 t/yr granular single superphosphate plant at the company's 1.9mn t/yr DAP and NP complex in Orissa.

Total phosphate rock resources in India are about 300mn t, of which about 25mn t are apatite and the remainder sedimentary. In terms of grade, resource estimates put the highest "chemical fertilizer" grade at about 20mn t.

Most of the rock in India is mined in Rajasthan by Rajasthan State Mines, a state-owned mining company. The main problem presented by the rock is the hard silica matrix (silica is chemically bound with the phosphate) content which inhibits filtration in the acid plant and causes significant abrasion of equipment in the reactor. Rajasthan State Mines offers the following grades:

Table 1-26: Rock Grades Offered by Rajasthan State Mines

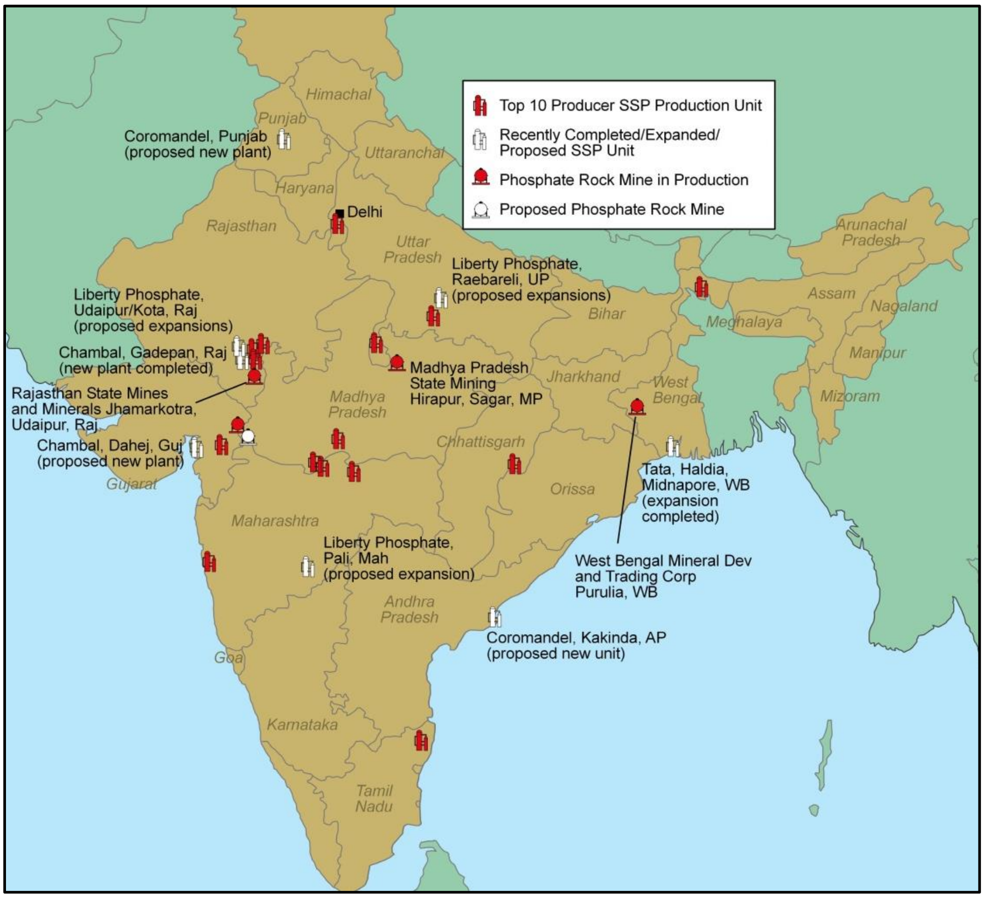
31.5pc P_2O_5	For single superphosphate manufacture
31.5pc P_2O_5	For non-single superphosphate plants
32.5pc P_2O_5	For nitrophosphate manufacture
31.54pc P_2O_5	For SSP, DCP and NP
18-20pc P_2O_5	For direct application
30-31pc P_2O_5	For yellow phosphorus production

— FAI

The flotation beneficiation process is able to remove some of the magnesium lime carbonate from the rock, but not the silica. The volumes of rock mined are small — about 1.6mn-1.7mn t/yr of concentrate is produced by Rajasthan State Mines and a further 250,000-300,000 t/yr by other mines. Only in the mid-1990s did production pass the 1mn t/yr mark and until 2010-11 it hovered around 1.5mn t/yr. The rock-mining sector now includes the first private-sector mining company, Krishana Phoschem.

The Indian government has recently announced an initiative "to encourage the conversion of phosphate rock resources into reserves across three provinces" — likely to be Rajasthan, Jharkhand and Madhya Pradesh — in order to supplement growing import supply. Madhya Pradesh launched a project in 2010 to develop a site at Meghna Nagar to produce 1.5mn t/yr of rock, although no positive announcement on progress has since been made. Given the quality of rock in most of India, lower-analysis phosphate fertilizers would be more likely to be produced than high-analysis phosphoric acid-based products, if the domestic industry is to make a significant contribution. The highest grades of rock are likely to be directed towards nitrophosphate production and increasing output, leading to a gradual reduction in the rock grades available for single superphosphate manufacture. The likelihood is that single superphosphate grades of 15-16pc P_2O_5 and 10-11pc S will be produced where local rock is utilized.

Figure 1-7: SSP in India - Major Producers and New Capacity



In view of the limited rock resources available, some of the production already uses imported rock. Importing low-quality (non-acid grade) rock undermines the aim of greater self-sufficiency and low costs. The two major suppliers of low-grade, inexpensive rock are Syria and Egypt. The availability of this material (27-30pc P_2O_5) which is mainly used for direct application, blending with other rocks to provide a feed for phosphoric acid manufacture and single superphosphate production, has been adversely impacted by political unrest in the region. This in turn has impacted prices, and it will no longer be sold at less than half the equivalent of Moroccan 31-32pc P_2O_5 rock. A proportion of rock imports from Egypt, Algeria, Peru and Syria is serving the single superphosphate market, as well as providing a blend-component in phosphoric acid feed.

Whether produced locally or imported, Indian single superphosphate consumption is likely to grow over the next five years. Every 1mn t of additional output will yield 160,000 to 180,000t of additional P_2O_5 and about 100,000t of additional fertilizer sulphur.

Areas of Positive Agricultural Demand

There are a number of countries where there is demand for a sulphur-containing phosphate fertilizer. In most applications — for example, on cereals, sugar or rapeseed — it is agronomically sensible to apply sulphur together with nitrogen during the main plant growth period. The exceptions have tended to be Oceania, where sulphur has been required on pastureland, and Brazil and north Argentina where agricultural demand for sulphur is driven by soybean, which fixes its own nitrogen. Soil in Brazil and Oceania has a low-sulphur content that needs to be topped up by fertilizer sulphur application.

Oceania's demand for single superphosphate has fallen for a number of reasons:

- Ploughing of pastureland for arable use;
- Closure of single superphosphate capacity on cost grounds — the shipping of rock and sulphur has proven expensive compared with shipment of ammonium phosphates;
- Development of specialised sulphur-containing fertilizers for specific areas and crops.

Production capacity for single superphosphate in Oceania has declined over the past 20-30 years, and many small units have closed. But existing capacity is sufficient to cover demand. The situation is presented in the table below:

Table 1-27: Oceania Single Superphosphate Capacity	***'000t product***
Company	**Capacity**
Incitec Pivot (Geelong/Portland, Victoria)	720
CSBP (Western Australia)	200
Impact Fertilizer (Tasmania)	180
Australia Sub-total	**1,100**
Ravensdown	870
Balance	715
NZ Sub-total	**1,580**
Total	**2,680**

Like China and India, most incremental demand for P_2O_5 has been supplied in the form of high-analysis fertilizers, although demand growth in Oceania is not substantial, and in the second half of the 2000's was put into reverse by several years of severe drought.

Brazil and north Argentina are the only major areas of single superphosphate production, with the exception of Egypt, that are actively expanding capacity.

Most countries have single superphosphate plants that are old, small and produce other materials, so capacity figures are not useful. China has hundreds of such plants. Whereas Brazil's single superphosphate production is part of the modern fertilizer sector, albeit that some plants are long established. Capacity details are therefore more significant and most of the existing capacity is operating at close to full production. Brazil is one of the few countries where investment is being made in new single superphosphate capacity.

Table 1-28: Single Superphosphate Capacity in Brazil*			*'000 t/yr*
Company/Location	P_2O_5 **Content, *pc***	**Capacity**	**Notes**
Total		**9,465**	
Cibrafertil		**230**	
-Camacari, BA	18	230	
Anglo American		**1,550**	
-Catalao, GO	18	550	
-Cubatao, SP	18	1,000	
Fertilizantes Heringer		**250**	
-Paranagua, PR	18	250	
Fospar		**520**	
-Paranagua, PR	18	520	
Galvani		**1,100**	
-Luis Eduardo Magalhaes, BA	18	400	
-Paulinia, SP	18	700	
Itafos (MBAC)		**500**	
-Arraias, Bahia	18	500	On stream, 2012-13
Mosaic Fertilizantes		**295**	
-Cubatao, SP	18	295	
Timac Agro		550	
-Candeias, BA	18	180	
-Santa Luzia do Norte, AL	18	120	
-Rio Grande, RS	18	250	
Vale		**3,620**	
-Araxa, MG	18	1,350	Combined granular and powder
-Catalao, GO	18	350	Combined granular and powder
-Cubatao, SP	18	640	Combined granular and powder
-Guara, SP	18	400	Combined granular and powder
-Patos de Minas, MG	22	250	Combined granular and powder
-Uberaba, MG	18	630	Combined granular and powder
Yara Brazil		**850**	
-Rio Grande, RS	18	850	
**figures reported are effective capacity*			

— Argus Consulting

A number of new single superphosphate plants have been built in Brazil in recent years, such as the new 500,000 t/yr plant constructed by MBAC using rock from its new Arraias mine. Commercial production began in 2013 adding over 50,000 t/yr of fertilizer sulphur to availability when operating at full capacity. However, MBAC suspended production at its Itafos Arraias plant in early 2015 to preserve working capital, after reporting a $43.2mn loss for the first quarter of 2015 because of foreign exchange losses and finance expenses. At the time of writing, the company expects to resume production if and when its strategic review process is successfully completed and its liquidity constraints are resolved. Possible options under consideration include, among others, securing a strategic partner, the sale of the company or its assets as well as other potential value-maximizing transactions.

A 410,000 t/yr unit is being built by Galvani as part of the Serra do Salitre project and is due to come on stream in 2020-21.

Single superphosphate is expected to continue to supply up to half of sulphur fertilizer in Brazil. In addition to its nutrient content, it has the advantage of being made from local rock deposits that are distributed across the country. This obviates some of the enormous logistical problems that affect imported product, although internal transportation over any distance is just as fraught. It will continue to be a mainstay of soybean fertilization.

Egypt is the other major producing country that has developed a preference for single superphosphate, all of which is produced domestically. The country's capacity is as follows:

Table 1-29: Single Superphosphate Production in Egypt					*'000t product*
Producer	**2009/2010**	**2010/2011**	**2011/2012**	**2012/2013**	**2013/2014**
EFIC	334	428	470	486	530
Abu Zaabal	227	372	379	371	431
Suez Co	311	134	270	216	408
Total	**872**	**934**	**1,119**	**1,074**	**1,369**
					— Abu Qir Fertilizers.

The P_2O_5 content of Egyptian powder single superphosphate is around 15pc. Export-quality granular product has to have a minimum 18pc P_2O_5 content (probably total P_2O_5). This raises the question as to how much of the phosphate concentrate sold to manufacturers in Egypt is capable of being upgraded to 18pc material. In single superphosphate the problem of low concentration in the final product is directly related to the P_2O_5 content of the rock used. In Abu Zaabal, acid from a new Chinese-built phosphoric acid plant is being used to top up the P_2O_5 content of single superphosphate to achieve export specification. Two new Chinese single superphosphate units have been built and operate alongside an older European-designed unit.

Other Production

Outside the majors, production of single superphosphate amounts to less than 1mn t/yr P_2O_5. Production in these other countries is essentially made up of old residual capacity that has been maintained for one reason or another:

- Government ownership or protection;
- The existence of a residual market for straight single superphosphate;
- The development of a new niche market;
- As a P_2O_5 and sulphur input for the manufacture of compounds and blends;
- As an outlet for fatal acid that cannot be disposed of in other ways.

5.2. Main conclusions

The main conclusions are as follows:

- We expect no surge of growth in single superphosphate on a global scale;
- On a local level we will see some investment, for example in Brazil and India, and probably in other countries where phosphate rock is either scarce and/or of too poor quality to justify phosphoric acid production;
- The new dynamics for phosphate rock and a growing requirement for sulphur and calcium could lead to a resurgence in capacity, possibly in Africa where the occurrence of small rock deposits would permit small operations suited to a local or regional market. Logistics (sulphuric acid in and final product out) will prove the real restraint.

Chapter 6: Minor Phosphate fertilizers

The following section briefly covers a number of fertilizer phosphate products that do not normally feature in market analyses.

6.1. Calcium Phosphates

There is practically no voluntary production of fertilizer-grade calcium phosphate. Both monocalcium phosphate (MCP) and dicalcium phosphate (DCP) are essentially produced as higher-value feed and food additives. Monocalcium phosphate is the dominant form of P_2O_5 in superphosphates, but in animal-feed grades other impurities are removed. There are some fertilizer sales of dicalcium phosphate from units that produce it as a by-product and cannot meet the more demanding specifications required for dietary additives, or dental grades. For example, one of the more important by-product sources is the synthetic manufacture of potassium sulphate. The surplus hydrochloric acid is often used to acidulate phosphate rock, and calcium phosphate may be produced. Where the reaction and operation is sophisticated and controlled, a saleable feed-grade product accrues. Where this is not the case, as for example in the now closed JAFFCO operation in Jordan, the by-product dicalcium phosphate is only good for use in place of secondary rock in triple superphosphate manufacture.

6.2. Guano

Major deposits of guano are formed by the accumulation of the droppings of seabirds — sometimes supplemented by seal droppings — on islands and coastal areas. A lesser source is created by bat droppings found in caves, supplemented by the droppings of other cave-dwelling mammals and birds. Most significant cave deposits are measured in the hundreds or thousands of tonnes, and the largest reserves have been severely depleted. In addition to guano, there are some phosphate resources that are made up of guano that has reacted with the underlying rock. The best-known examples of this are Nauru and Christmas Island, where guano has filled cavities in the rock and reacted with it. Nauru's reserves were originally put at 90mn t averaging 39pc P_2O_5. The nature of the phosphatised rock depends on the composition of the host rock. In the case of limestone, as on many coral atolls, the resulting mineral is an apatite. Where the underlying rock is a silicate, as in areas of volcanic origin, the phosphate minerals take the form of aluminium or aluminium-iron phosphates.

Fresh seabird droppings contain about 22pc N and 4pc P_2O_5. However, over time the nitrogen tends to volatilise and/or leach, and so the nitrogen content falls in relationship to the P_2O_5 content. Phosphatised rock can have a much higher P_2O_5 content — as with Nauru up to 40pc. Most of the high-grade material has been exploited. Today guano from bird droppings will have a P_2O_5 content of around 10pc, although the nutrient content varies depending on ageing and location. A typical product in Europe has an NPK ratio of 1-10-1. However, it is also processed into a high-nitrogen guano with a formulation of 12-8-1, while a pelletized Peruvian guano is on offer with 10-10-2.5, of which 8pc of the nitrogen is organic.

Bat guano also varies widely in terms of nutrient content. A cave guano is offered in Europe with a nutrient content of 3-10-1. A desert guano from the southwest of Mexico has an 8-4-1 composition with 2pc soluble nitrogen.

In the developed world, this type of fertilizer is aimed at the hobby and organic horticulture sectors. In China, a wide range of guano products are available from a variety of stated sources, including Malaysia, Indonesia, Ukraine, the US and Australia. Some of these are unlikely origins, and probably describe the merchant address from where they are imported. The range of sources is matched by the range of nutrient contents attributed to the products. Much of the bat guano has a fairly low analysis, typically 6-6-1 or 6-3-1. But there are a number of products being offered with surprisingly high analyses:

- 25pc P_2O_5, 28pc CaO, 0.2pc K_2O (5pc moisture);
- 1-3pc N, 15-25pc P_2O_5, 1-3pc K_2O (6-7pc moisture, seabird guano, origin Australia);
- 18-28pc P_2O_5, 35pc CaO, 0.1pc K_2O (5pc moisture, origin India);
- 0.1pc N, 18-40pc P_2O_5, 0.07pc K_2O (5pc moisture).

This diversity of specification is mirrored by that of most other phosphate fertilizers in China — fused magnesium phosphate, single superphosphate or ground rock. There are offers of 17pc triple superphosphate, 37pc concentrated phosphate rock, and so on. This diversity can also be seen in the specifications for export-grade diammonium phosphate. There is clearly no uniformity in product description and specifications, which adds a degree of unreliability to the purchase of Chinese phosphate fertilizer materials.

6.3. Fused Magnesium Phosphate

Thermal treatment of phosphate rock increases the plant-availability of its phosphate content — measurable by its solubility in a 2pc citric acid solution — by breaking down the highly insoluble fluorapatite structure. The effect can be chemically enhanced by incorporating other input materials, notably soda ash (Na_2CO_3) to produce so-called Rhenania phosphate and magnesium silicates (or magnesite or dolomite plus silica) to produce fused magnesium phosphate (FMP). Phosphate rock that is unsuitable for processing by acidulation, either because it is too unreactive, or because it contains impurities that impair gypsum filtration, can often be used to produce these products.

Since this type of fertilizer is of greatest value when used on acidic, phosphate-fixing ferralitic soils commonly found in tropical zones, FMP is mainly produced and used in Asia-Pacific, especially China, South Korea and Vietnam, and in South America, particularly Brazil.

FMP, also known as CMP — which stands for calcium magnesium phosphate and indicates its composition more closely although still not precisely — or FCMP, is produced by fusing a mixture of phosphate rock and a magnesium silicate mineral such as olivine or serpentine in a furnace at around 1,500°C and then slaking the melt in water to produce vitreous particles with a high citrate-solubility (>90pc), followed by grinding, if required. Magnesium silicates are preferable to magnesite plus silica because of their lower melting point. Iron and aluminium oxides also enhance the fusibility of the mixture. Both olivine (Mg,Fe)2SiO4 and serpentine $(Mg,Fe)_3Si2O5(OH)_4$ contain iron in proportions that can vary according to the source.

In the FMP production process, no more than about 70pc of the fluorine content of the phosphate rock is removed in the furnace (the proportion is lower in an electric furnace than in fuelled types), and the rapid cooling achieved by quenching in water is essential to minimise reversion of the phosphate to the insoluble, unreactive fluorapatite form by recombination with the residual fluorine.

As with other thermally treated phosphates, volatile constituents of the phosphate rock are driven off, including toxic impurities such as cadmium and mercury. Depending on their original content and on the applicable environmental regulations, special abatement facilities may be needed to remove these from the furnace exhaust.

For historical reasons an electric furnace was originally used because the Tennessee Valley Authority, which did important early development work on FMP, was an electricity generator. But the power consumption is high, at around 850 kWh/t. A variety of different types of furnace, fuelled by coal, coke or oil, have been used. Electric furnaces can accept coarser raw materials than the other furnace types — flotation concentrate may need to be granulated or briquetted.

Calcium and magnesium, both of which are found in plant-available form in FMP, are rated as secondary nutrients — essential, but not in the same quantities as the primary nutrients (nitrogen, phosphorus and potassium). Calcium regulates the assimilation of other nutrients, and also affects the performance of certain plant enzymes. Magnesium is essential for chlorophyll generation. As alkaline constituents, both calcium and magnesium also moderate soil acidity.

Although not included in the list of conventional plant nutrients, silicates are increasingly recognised as having a beneficial effect on cell structure, contributing to the physical strength and hardiness of the crop plants. The silicate content of FMP is plant-available. It may also enhance the effectiveness of FMP indirectly by preferentially combining with iron and aluminium in the soil, which would otherwise tend to immobilise its phosphate content.

The eventual citric acid-solubility of the P_2O_5 in FMP depends on the proportions of CaO, P_2O_5, MgO and SiO_2, necessitating adjustment of the proportions of the input materials to take into account the varying CaO:P_2O_5 ratio in the rock and MgO:SiO_2 ratio in the magnesium silicate mineral. Because of these variations in raw material composition, the optimum molecular proportions can vary quite widely:

CaO	3.0-5.0
MgO	1.0-2.0
SiO_2	1.0-2.0
P_2O_5	1.0

Typical FMP products on the market have 15-22pc P_2O_5, 12-20pc MgO, 20-30pc SiO_2 and around 30pc CaO.

Because FMP is not water soluble, it is not susceptible to leaching and run-off, so does not contribute materially to eutrophication of surface waters. It also has a much lower caking tendency than soluble phosphates produced through the acidulation of phosphate rock.

On account of its high combined calcium and magnesium content (up to 50pc in total), FMP can take the place of all, or a large part, of the lime that is needed when using other fertilizers. Although single superphosphate, which has a similar P_2O_5 content to FMP, also contains a high proportion of CaO, FMP is essentially alkaline in character and reduces soil acidity. A number of comparative trials carried out in various Asian countries on crops such as rice, ground nuts and coffee have shown that FMP enhances yields more efficiently than superphosphate.

FMP is now only produced on a large scale in China and Vietnam. There are smaller operations in South Korea (Pungyong), which produces 20pc P_2O_5 material, and Brazil, where Mitsui produces about 90,000 t/yr of 16pc P_2O_5 material at Pocos de Caldos in Minas Gerais. The concentration of larger-scale production in east Asia is a function of a number of factors:

- The availability of local rock, much of which is not of acid quality;
- The availability of low-cost coal and energy;
- Establishment of the fertilizer industry in the 1960s by governments isolated from access to modern technology;
- Suitability for acid soil conditions.

Production of FMP and SSP (low concentration phosphate fertilizers) in China was estimated at about 1.6mn t in 2014, down from 1.9mn t in 2013, 3mn t in 2005 and 5mn-6mn t in 1995. In 2013, total production of FMP and SSP accounted for only 11.6pc of China's total phosphate fertilizer output, while it represented 94pc of it in 1990. The decline of this industry is expected to continue as a result of the economics of production and the limitations of the end-product.

The specification of FMP on sale in China varies significantly. The offerings generally range from 16-18pc P_2O_5, with 12-15pc MgO and 12-35pc CaO. Many merchants and factories claim their product to be 90pc "soluble", although the P_2O_5 is citric acid-soluble and not water soluble.

China's FMP/SSP exports increased by 24.1pc year on year in 2014 to 750,000t, after peaking at 1.73mn t in 2011.

Vietnamese company Ninh Binh Fused Magnesium Phosphate (Niferco) produces 300,000 t/yr of various grades of FCMP. The main grade is 15-17pc P_2O_5 plus 28-34pc CaO, 11-20pc MgO and 25-30pc SiO_2. The company also offers 15-17pc P_2O_5 and 19-21pc P_2O_5 products. The majority of phosphate rock is used without advanced beneficiation, producing grades of saleable rock of between 24pc P_2O_5 and 34pc P_2O_5. This accounts for the specification range for each product and the wide range of nutrient content of the final formulation between end-products.

6.4. Unacidulated Phosphate Rock

The use of phosphate rock that has not undergone any form of chemical processing has been a long-standing feature of the fertilizer industry. The use of unacidulated rock as a finished fertilizer is increasing, and as with so many phosphate fertilizers, the designation of these fertilizer rock products is often inexact.

"Reactive phosphate rock" is the term normally used for phosphate rocks that are effective in their own right when applied directly to the soil, without any prior chemical processing. However, they are only effective under certain soil and climatic conditions:

- Soil pH of less than 6.5;
- Annual rainfall minimum of 600-800mm;
- Soil temperature minimum of 10°C.

There are three sources of phosphate rock that are universally recognised as being highly reactive — Bayovar, Gafsa and North Carolina. The reactivity is based on the isomorphic substitution of the $(PO4)^{3-}$ ions in the apatite crystal lattice by $(CO3)^{2-}$ ions. To maintain ionic neutrality, there is also a substitution of Ca^{2+} by Na^{+}. These changes cause measurable distortions in the crystal structure. The agronomic efficiency is correlated to the degree of the distortion. In layman's terms, the distortion in the crystal structure weakens the chemical bonds that otherwise prevent the P_2O_5 from being released to the soil in a form that plants can absorb.

To be available for absorption by crop plants, any phosphate applied to the soil must dissolve at least partially in the soil solution. The chemical make-up of the soil solution and the phosphate-dissolving characteristics vary according to local pedology and climate. In the agriculturally advanced regions of the northern temperate zone, soils are predominantly calcareous and the soil solution is neutral or slightly alkaline, although in the past it was affected by acidic rainfall which resulted in a requirement for liming. For maximum effect, the phosphate content of any applied fertilizer should ideally be water soluble, but even when there is a water-insoluble component it may be at least partially plant-available because of humic acids and other constituents of the soil solution. This is emulated in laboratory tests using a solution of ammonium citrate that is buffered to be neutral or slightly alkaline. Strictly speaking, the citrate-soluble portion of a fertilizer's phosphate content is the proportion of the total (expressed as a percentage) that does not dissolve in water but does dissolve in ammonium citrate. But the water-soluble component is often included to give an overall indication of the plant-available phosphate.

In most tropical and sub-tropical regions, the soil is more acidic and the ammonium citrate buffer solution is inappropriate. The best reagent for measuring the available phosphate content of reactive phosphate rocks is 2pc formic acid, although citric acid can also be used. Because there is essentially no water-soluble phosphate in phosphate rock, the formic (or citric) acid soluble portion represents the total plant-available phosphate content. Although this may be quite a small proportion of the total phosphate content, in many cases there would be little or no benefit from having a water-soluble content because high concentrations of phosphate in the soil solution react with the iron and aluminium compounds in the soil to form very insoluble phosphates and so are rendered unavailable to crop plants.

In general, reactive rocks are applied to tree and bush crops — oil palm, rubber or tea — as a background application of phosphate that can be topped up with water-soluble phosphate during critical periods of the fruiting cycle. It is not particularly well suited to crops with short growing periods such as vegetables or rice. In all cases reactive rock works only in acid soils. The option of upgrading low-grade reactive rock by calcining can adversely affect the reactivity of the rock.

The Bayovar operation is unlikely to sell much rock specifically for direct application because it can achieve a better return on rock sold for acid production. The availability of the most reactive material, Gafsa, theoretically amounts to 1.5mn t/yr. In practice, growing requirements for downstream acid production are limiting the volume sold as direct application material to about half that amount. PCS does not market North Carolina phosphate rock as a direct application product, requiring all output for internal processing.

A second group of phosphate rocks with high solubility in citric and formic acids are also sold for direct application:

- Arad from Israel;
- Daoui from Morocco;
- Djebel Onk from Algeria.

With limitations on the availability of reactive rocks from Tunisia and Bayovar, they are being exported in increasing quantities.

In 2013, OCP launched a range of highly reactive rock products (the Terractive range), based on ore mined in Benguerir. The straight rock product is supplemented by the addition of calcium sulphate to produce a 22pc P_2O_5, 43pc CaO, 5pc S product. In addition, the company produces a number of rock-based multi-nutrient fertilizers designed for specific crops and with the African market in mind:

Teractiv Corn:	0-18-12-31 CaO-4.8 S-0.3 B_2O_3-0.7 Zn
Teractiv Cotton:	0-17-13-30 CaO-2.6 MgO-5.3 S-0.7 B_2O_3-0.3 Zn

There is a third category of rock that is finding increasing use in unprocessed form. These are rocks with a minimum 27pc P_2O_5 content and a minimum 7pc citric acid-soluble P_2O_5 content. Such rocks do not display particular reactivity, but in quality and price appear suited to the fast-growing plantation sectors in southeast Asia.

Traditionally, Egyptian Red Sea ground phosphate rock was exported as direct application material. The ground rock product has about 25pc P_2O_5. Details of reactivity, solubility or even P_2O_5 content vary and tend not to be precise. Other Egyptian rock, for example from Abu Tartur, has been exported recently, some for blending into a phosphoric acid feed and some being used as such or in multinutrient compounds. Since its high-grade rock exports were terminated, Christmas Island has developed a blend suitable for direct application in the southeast Asian market, along with low-grade rock from a variety of other sources such as China and Vietnam. These latter two countries have also developed a granular phosphate rock for use in blends. Impurities such as magnesium, which adversely affect processing into phosphoric acid, are not significant in direct application material (or, indeed, in single superphosphate). Some low-grade rock is also available locally in Indonesia and elsewhere in southeast Asia, where guano and guano-based rocks are available — but in very small volumes. In Indonesia some rock is ground and mixed with a small quantity of sulphuric acid to produce a form of partially-acidulated phosphate rock (PAPR), which can be granulated for use in blending. Very small volumes are used in single superphosphate manufacture. A higher-grade (and effective) PAPR, was developed in New Zealand and uses a reactive rock and 50pc of the phosphoric acid used in the production of TSP — it is currently produced by Ballance Fertilizers.

A number of rock sources in Africa are being exploited on a small scale for local use — for example, Mingingu phosphate from Tanzania. This is one of several reactive rocks in sub-Saharan Africa that often occur in a single seam in ore-bodies where the other seams are less reactive. A small-scale operation is also to be found in Malawi. Most phosphate rock also contains calcium, which is a limiting factor in African agriculture and therefore has value as a secondary nutrient that may or may not be recognised in pricing. In world terms this type of locally-used phosphate rock is not significant but, in African terms, it represents a promising innovation in countries that do not have access to high-grade imported fertilizers.

Chapter 7: Ammonium Phosphates

7.1. The Ammonium Phosphates Industry

7.1.1. Introduction

Assessing the production capacity for ammonium phosphates is notoriously difficult. The critical aspect of the definition is the granulation capacity of a plant. The main problems are as follows:

- Multiple use of streams or the capability to switch products. Increasingly, complexes are being designed to be able to produce a range of phosphate products, notably diammonium phosphate, monoammonium phosphate, triple superphosphate and NPK products. A recent example is the joint-venture complex between OCP and Bunge at Jorf Lasfar (now 100pc owned by OCP), which is able to produce ammonium phosphates and triple superphosphate. The rates at which each of the products can be put through the reaction and granulation sections varies, so the capacity of the complex depends on the product mix. In some cases, companies will present capacity in terms of the 100pc output of all products, which leads to an overstatement of the practical production capability;

- Issues of production practicality and economics mean that each reaction and granulation stream is normally devoted to a single product. Regular switching is too costly in terms of downtime. If a switch does take place, for example from monoammonium phosphate to diammonium phosphate, an increase in throughput of up to 25pc can be achieved. This goes some way to explaining the general preference for diammonium phosphate production in market economy countries in the days when rock quality constraints were not as important as they are becoming today. Switching from triple superphosphate to any ammonium phosphate increases throughput;

- The entry onto the international market of Russian monoammonium phosphate has eroded the dominance of diammonium phosphate as the main, traded ammonium phosphate product. Its introduction has resulted in a positive demand preference in some importing countries, especially Brazil. As a result, producers such as OCP, GCT and recently Ma'aden feel obliged to offer monoammonium phosphate and thereby reduce capacity for diammonium phosphate. Conversely, some Russian ammonium phosphate exporters have felt the need to introduce diammonium phosphate to their product range to diversify markets and to allow the shipment of combined cargoes;

- Chronic medium-term uncertainty created by the Indian system in respect of the form of P_2O_5 that can be shipped into India, is leading major suppliers of merchant phosphoric acid — mainly Morocco — to increase granulation capacity in case they have to switch from acid to deliveries of solid ammonium phosphate products. This capacity will remain unused when acid shipments are in full flow, but nonetheless it will be registered as production capacity. For example, OCP can convert all the acid produced at the Maroc Phosphore plants at Jorf Lasfar into solid product if necessary. The fear that the availability of diammonium phosphate from the Ma'aden complex would cause a major shift in Indian strategy has driven investment in precautionary flexibility;

- The production of phosphoric acid at an individual site may not be a firm guide to the production capability for ammonium phosphates. Acid may be diverted to the production of triple superphosphate and technical products, NPKs or sold as such. Each production complex has a unique footprint.

The diversification of the ammonium phosphate industry towards new producers such as China, and the development of small existing industries in countries such as Kazakhstan and Uzbekistan, are resulting in non-standard ammonium phosphate products appearing on the market in greater volumes. Products such as east European "Ammophos" have formulations of 10-46-0 or 10-44-0 simply because this is the easiest grade to produce. In China there is a wider range of formulations, some of which — lacking the higher P_2O_5 content typical of ammonium phosphates — are attracting the new designation of "mini-DAP" or "DAP-lite". Since most of these products were originally destined for the local market, there was little incentive to undertake expensive measures designed to achieve international specifications. More recently, the introduction of the nutrient-based subsidy system in India has led to these non-standard products gravitating to that market. The most common "lite" monoammonium phosphate being produced in China is 11-44-0. The US industry has been producing a 10-50-0 monoammonium phosphate for many years. The most common "lite" diammonium phosphate produced in China is 16-44-0, which was included in the approved Indian nutrient-based subsidy scheme in 2011. This development is likely to create problems for buyers of diammonium phosphate because of the import specifications laid down for P_2O_5 content, water solubility and total availability to plants, composition of the nitrogen component (ammoniacal and urea) and physical quality.

Rock quality and production issues often determine the exact type of ammonium phosphate that an industry produces. Much less consideration is given to some differences between diammonium phosphate and monoammonium phosphate, in terms of their chemical properties and agronomic performance.

Phosphoric acid is tri-basic, so it is possible to convert it to three different ammonium salts by neutralising it with differing proportions of ammonia:

- 1 mole of ammonia to 1 mole of acid yields monoammonium phosphate, MAP (ammonium dihydrogen phosphate, $NH_4H_2PO_4$);
- 2 moles of ammonia to 1 mole of acid yields diammonium phosphate, DAP (ammonium hydrogen phosphate, $(NH_4)2HPO_4$);
- 3 moles of ammonia to 1 mole of acid yields triammonium phosphate, $(NH_4)_3PO_4$.

The last of these is very unstable and spontaneously loses ammonia in the presence of moisture so readily that it is too difficult to isolate to have any practical use. Diammonium phosphate is sufficiently stable to be stored and traded internationally. It has a higher nitrogen content than MAP (around 18pc as opposed to 10-11pc), but in terms of total nutrient content the two are very similar. The main advantages of diammonium phosphate stem more from its agronomic properties than the economics of transportation.

Although diammonium phosphate still contains one acidic hydrogen atom, it is actually mildly alkaline. A saturated solution has a pH of about 8 (compared with pure water, pH = 7). The corresponding pH value for monoammonium phosphate is about 3.5 (moderately acidic). In the presence of moisture, diammonium phosphate is therefore susceptible to hydrolysis resulting in the formation of free ammonia.

$(NH_4)_2HPO4+H2O \rightleftharpoons NH4(H_2PO_4)_2+NH_4OH$

$NH_4OH \rightleftharpoons NH_3+H_2O$

Because the product of hydrolysis is acidic, hydrolysis will only continue to the point at which there is balance between the acidity of the monoammonium phosphate molecules and the alkalinity of diammonium phosphate. This point is reached when about 8pc of the ammonia content of the diammonium phosphate has been lost, assuming that the ammonia vapour can escape, as in a ventilated bulk store. In a confined space the ammonia will tend to recombine, so equilibrium will be established at a lower rate of loss.

Under normal conditions, ammonia loss in storage is so gradual as not to merit any mention in manufacturers' material safety data sheets. But it can be a potentially significant economic concern where diammonium phosphate is stored for extended periods, particularly under unfavourable environmental conditions (high temperature and humidity).

A more significant loss of ammonia can occur when diammonium phosphate is applied to alkaline soils or even nearly neutral calcareous soils, which are common in temperate regions, as here alkaline species in the soil may displace ammonia. Not only is this wasteful, it can temporarily increase the alkalinity of the soil, while the free ammonia can impair germination if the ammonium phosphate has been applied at the seeding stage. As much as 14pc ammonia loss has been observed in trials. However, under comparable conditions ammonia losses from urea tend to be higher still ($\leqq$ 25pc). This problem necessitates caution in the use of diammonium phosphate-based fertilizers in the early stages of crop growth. Free ammonia formation is of much less significance in acidic soils, since any ammonia released by hydrolysis tends to combine with acidic species in the soil.

Unlike triple superphosphate, there is a startling growth in ammonium phosphates capacity. The latest listing of current and medium-term changes in diammonium phosphate and monoammonium phosphates capacity is presented in the *Outlook* section. Here, the focus is on the highlights of developments in capacity and production.

Table 1-30: World Diammonium Phosphate Capacity						*mn t/yr product*
	2005	2010	2011	2012	2013	2014
World Total	**43,378**	**49,571**	**51,366**	**54,456**	**57,646**	**60,536**
West Europe	2,380	2,480	2,480	2,480	2,370	2,290
EECA	2,641	2,791	2,231	2,231	2,231	2,231
Africa	3,594	4,804	5,304	5,304	5,984	6,664
North America*	12,297	11,297	10,852	10,802	10,802	10,802
Latin America	200	872	872	872	872	1,122
Middle East	1,594	1,694	2,094	3,294	4,194	4,694
South Asia	7,610	8,461	8,461	8,461	8,461	8,461
Southeast Asia	165	495	495	495	495	495
East Asia	12,097	15,877	17,737	19,677	21,397	22,937
Oceania	800	800	840	840	840	840

**Including Micro Essentials*

— Argus Consulting; EECA- East Europe/Central Asia

Table 1-31: World Monoammonium Phosphate Capacity						*mn t/yr product*
	2005	2010	2011	2012	2013	2014
World Total	**17,945**	**23,588**	**23,983**	**25,293**	**26,433**	**28,093**
West Europe	110	110	85	60	60	60
EECA	3,180	3,095	2,895	2,895	2,895	2,895
Africa	1,085	1,285	1,240	1,310	1,480	1,650
North America*	6,250	4,790	4,790	4,790	4,790	4,790
Latin America	1,315	1,613	1,688	1,763	1,763	1,763
East Asia	5,805	12,455	13,045	14,235	15,205	16,695
Oceania	200	240	240	240	240	240

**Including Micro Essentials*

— Argus Consulting; EECA- East Europe/Central Asia

Ammonium phosphates capacity totalling a net 27.3mn t/yr came on stream in 2005-14. The figure may double-count some capacity that China lists as diammonium phosphate, but which could be producing monoammonium phosphates (around 4.5mn t/yr of unspecified monoammonium phosphates capacity have been added to match reported production while diammonium phosphate capacity is significantly above actual production), or the additional monoammonium phosphate production might be associated with plants listed as NP/NPKs. In China, the large volume of production of “lite” or “mini” MAP/DAP products blurs the interpretation of ammonium phosphates capacity further and may eventually lead to new classification systems for ammonium phosphates.

7.1.2. Europe

Ammonium phosphates capacity in Europe is limited to three plants in Lithuania, Bulgaria and Poland. The Lithuanian plant (Lifosa) is owned by Russian company Eurochem, which supplies part of its rock requirements from its Kovdor mine. It is really an extension of the Russian industry, and as such has a positive future. The same cannot be said for the Police plant in Poland, which is under environmental pressure and is dependent on a merchant rock supply. In our base capacity projections, it is assumed that this unit will continue to produce a greater proportion of NPKs. Agropolychim has reopened facilities in Bulgaria with a nameplate capacity of 260,000t, although production continues to be focused on triple superphosphate. The small production of ammonium phosphates at Huelva in Spain was permanently closed in December 2013. The plant had been idle or sporadically operational and the closure occurred despite Fertiberia agreeing a phosphoric acid supply contract with OCP in 2011. Most of the plant's production had been for powder monoammonium phosphates sold on to blenders. It also explains Fertiberia's involvement in developing new projects in Algeria, in particular the Ferfos project, but little progress has been made on this.

The Russian industry is the major driver in eastern Europe. It has entered a phase of consolidation and reinvestment rather than new investment in downstream facilities. The ownership of the industry is being streamlined with PhosAgro and Eurochem emerging as the major participants. Acron has licences for a second phase of its Oleniy Ruchey phosphate mine that will guarantee its supply of phosphate rock for current output, and any future expansion of NPK production. Uralchem continues to suffer from unreliable supply from PhosAgro, which forced the company to shut down its Voskresensk phosphate plant in the first quarter of 2014 (nameplate capacity of 750,000 t/yr of DAP/MAP/NPKs). In January 2015, Russia's Supreme Court refused Uralchem's request to extend its phosphate rock supply contract with PhosAgro/Apatit under the older agreement on the grounds that it was economically unjustified. The plant is likely to remain idle until the end of 2015, but there have been no formal confirmations of its long-term status or restart date. Uralchem has also dropped plans to extend its activities to rock mining for the time being. Eurochem and PhosAgro have sufficient rock to satisfy their downstream requirements in Russia and Eurochem is investing in a rock mine in Kazakhstan to enable it to free more Kovdor rock for its Lifosa subsidiary in Lithuania (ore production started in July 2014).

These developments are relevant to the general trend in the Russian phosphate sector. The first priority is to create a downstream manufacturing base of sufficient size to justify further investment. The second priority is to acquire and develop captive phosphate rock resources since the supply from competitors, such as PhosAgro, is likely to be expensive, unreliable at best, or simply not available. In terms of the processing units, the first priority is to revamp and modernise existing units and adjust the output to meet modern international norms and changing market requirements. Russia has traditionally been a manufacturer of monoammonium phosphate, but Eurochem has modified its complexes at Belorechensk to produce NPS grades and at Fosforit to produce diammonium phosphate to increase its export flexibility.

Overall, Russia has an estimated capacity for 1.2mn t/yr of diammonium phosphate and 2.4mn t/yr of monoammonium phosphate, after accounting for recent switches to the production of NPS and NPKs.

Table 1-32: Russian Ammonium Phosphates Capacity, 2014		*'000t product*
	Diammonium phosphate	**Monoammonium phosphate**
Total	**1,189**	**2,345**
Balakovo (PhosAgro)*	150	150
Cherepovets (PhosAgro)*	650	700
Uralchem, Voskresensk	239	480
Eurochem, Belorechensk	-	465
Eurochem Fosforit, Kingisepp	150	550

**PhosAgro states a nameplate capacity of 2.45mn t/yr of DAP/MAP/NPS with fully flexible production lines and NPS production capacity up to 1mn t — assuming a 800kt NPS capacity*

— Argus Consulting

In the medium term, when rock supply is secure, investment in further downstream processing is likely. PhosAgro recently announced plans to raise its DAP/MAP/NPS/NPKs production by 500,000 t/yr by 2020. The company sees major growth opportunities in Russia, based on the relatively low ratio of harvested crop area to available arable land. But Acron has not reported any plans to expand its NPK capacity.

7.1.3. Africa

The only recent investment activity in ammonium phosphates capacity in Africa has been in Morocco. This concentration of investment in Morocco is significant for the industry as a whole, as it confirms the current trend of investment being focused in a handful of countries with the rock resources to justify it. Unlike nitrogen, there is not such a wide scattering of raw material resources available to support capacity. For many years OCP has followed a strategy of mixing investment in Morocco with joint ventures in Morocco and offshore. This approach has been accelerated by a perceived threat of exports of diammonium phosphate from Saudi Arabia's Ma'aden project, located adjacent to the world's largest market for P_2O_5. OCP has also moved to position itself in the North American and Latin American markets, so that it is able to take advantage of the continuing decline in the US phosphate industry. During the third and fourth quarters of 2010, the first exports of diammonium phosphate were made into the US market, with customs data indicating 210,000-250,000 t/yr P_2O_5 of Moroccan exports of ammonium phosphates to the US in 2013 and 2014, spurred by the closure of the Agrifos unit.

OCP has invested in an optimisation project at the Jorf Lasfar site, which has seen two granulation units added during 2013 totalling 1.7mn t/yr. Added to this will be the first phase of new capacity additions under the Jorf Phosphate Hub programme (JPH), which will include the completion of four integrated units with a capacity of 450,000 t/yr P_2O_5 to be built at six-month intervals between 2015 and 2016. The first unit, due on stream in July 2015, will produce DAP/MAP/NPK/NPS and will be fully dedicated to the African market, as announced by OCP in 2014, while the second unit should come on stream in the fourth quarter of 2015.

OCP has also started to produce ammonium phosphate sulphate and other modified ammonium phosphates enriched with micronutrients (Boron and/or Zinc) to address the increasing demand for enhanced fertilizers. They include:

19-38-0-7S
12-46-0-7S
12-48-0-5S
12-45-0-5S-1Zn
15-15-15-10S
15-15-15-6S-1B2O3
12-24-12-4S
10-20-10-6S
20-20-0-10S
10-20-10-6S-1B2O3-0.5Zn
12-20-18-5S-1B2O3

The most recent development was the awarding of over 350,000t of NPS 19-38-0+7S to the Ethiopian market for Q1-Q2 2015 shipment. This further blurs strict capacity differentiation between diammonium phosphate, monoammonium phosphate and a new breed of modified ammonium phosphates.

The following table gives an overview of OCP's investment activity to 2016.

Table 1-33: Effective OCP Ammonium Phosphate Capacity, 2014-16		*'000t product*
	2014	**2016**
Total DAP/MAP Capacity	**6,100**	**9,900**
Of which		
OCP Maroc Phosphore	3,900	3,900
2 granulation lines operational since 2013*	1,700	1,700
Jorf Fertilizer (previously JV with Bunge)	500	500
JPH: 4 new integrated DAP/MAP units with a capacity of 450,000 t/yr P_2O_5 each	-	3,800
**granulation capacity is also used for NP/NPK production*		

— Argus Consulting

The recently-announced proposal for a joint venture with the government of Gabon gives an insight into the development of OCP's strategy especially in Africa. The combination of ammonia produced using Gabon gas at Port Gentil and imported phosphoric acid from one of the new units being built at Jorf will provide a platform for fully fledged multinutrient fertilizers containing macro, secondary and micronutrients. The focus will be on Africa specific products to unlock demand in sub-Saharan Africa, many of which will have a higher nitrogen content than the modified ammonium phosphates being produced.

It is assumed the two units associated with the OCP/Gabon joint venture will come on-stream in 2019. The remaining four units under the JPH programme are expected to come on stream after 2020. The actual timing will depend on the evolution of the global supply-demand balance for ammonium phosphates. OCP has the infrastructure in place to be the first to implement new capacity in response to market developments.

On the other hand, OCP is investing in the development of the new Safi complex under the Safi Phosphate Hub programme (SPH), through the addition of further integrated fertilizer production units and the transfer of the current assets to a new platform which will enable ammonia imports from the new Safi port currently under construction. The SPH platform is expected to start operations in 2021, with a phosphoric acid capacity of around 2.5mn t P_2O_5 along with associated granulation capacity for the production of NPKs, Feed Phosphates, and TSP according to the below split:

- 3mn t/yr NPK (i.e. an additional capacity of 3mn t/yr vs. current site capacity)
- 0.6mn t/yr Feed Phosphates (i.e. an additional capacity of 300,000 t/yr vs. current site capacity)
- 1.5mn t/yr TSP (i.e. an additional capacity of 500,000 t/yr vs. current site capacity)

A further integrated DAP/MAP unit with a capacity of 450,000 t/yr DAP/MAP is expected to come on stream in 2022, bringing the total end profuvt capacity of the SPH platform to almost 2.8mn t P_2O_5.

Last but not least, the addition of downstream capacities at Boucraa and the development of the Laayoune port are currently under study.

At the other end of the scale, GCT's production in Tunisia has been severely disrupted since early 2011 following the revolution, resulting in numerous strikes and sit ins at the plants. As of May 2015, finished phosphates production was completely down with all plants affected, due to a strike action by unemployed youths in the main rock producing region of Gafsa. This has halted train supplies of phosphate rock from Gafsa to DAP/TSP production facilities, where stocks of phosphate rock are said to have been exhausted. GCT produces DAP at Gabes on two lines, each with a capacity of 650,000 t/yr. At the time of writing, the Tunisian producer is building up rock inventory before the plants restart, expected end-June 2015.

In South Africa, there has been a divestment of phosphate fertilizers production by Sasol, resulting from Foskor declaring itself no longer able to supply the phosphate rock requirement for the Secunda plant. Since that decision, Foskor’s Richards Bay acid plant has suffered serious technical problems and is now operating at half capacity at best. Substantial investment is required to rehabilitate the complex, which has been allowed to run down over recent years.

7.1.4. US

The decline in US production has long been predicted as phosphate rock resources decline and environmental pressures increase. This phase will be gradual and result in a reduction in both capacity and export availability. Already the industry is able to focus on the US domestic market and its most freight favourable export destinations. The latest developments of the US industry are summarised below:

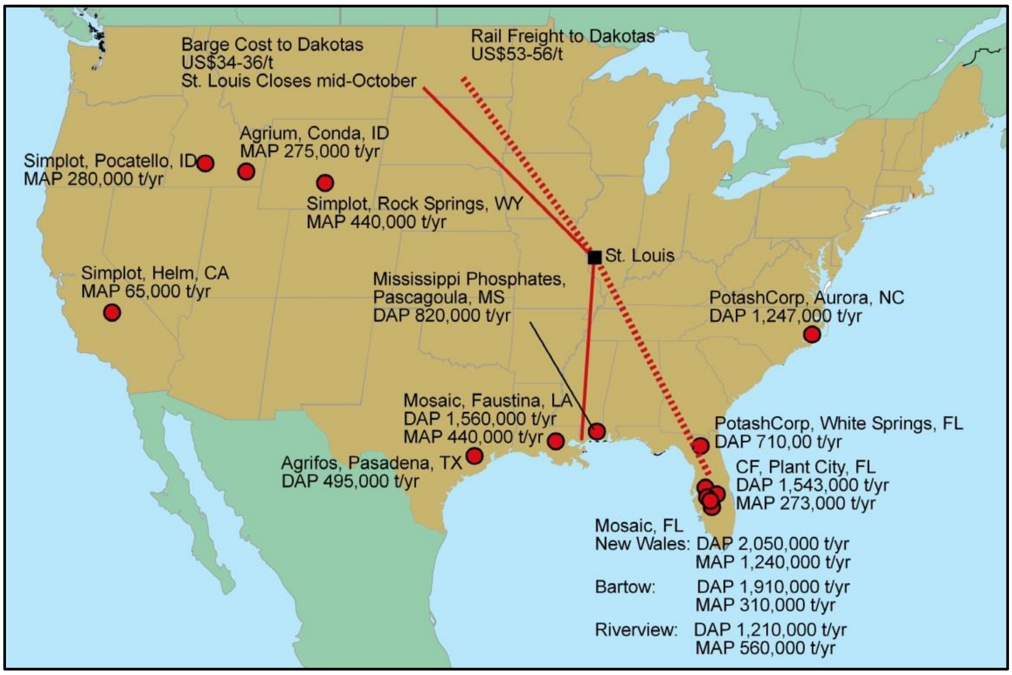
- PCS closed its Suwannee River phosphoric acid plant in July 2014. While the closure will be partially offset by increased operating rates at the Aurora North Carolina facility, PCS anticipates a net loss in production of 215,000t P_2O_5 by 2015. However, the granulation facilities at White Springs will continue to operate as normal and it is assumed that the company will maintain its granulation capacity.

- Mississippi Phosphates (MissPhos) declared Chapter 11 bankruptcy in October 2014 and ceased phosphoric acid and DAP production at its 850,000 t/yr DAP Pascagoula plant in December 2014. The loss of production was widely expected given that the company endured several difficulties, exacerbated by increasing phosphate production costs and falling domestic DAP prices amid lacklustre demand.

Prior to 2014, the Agrifos Pasadena complex ceased production at the start of 2011 because of problems with phosphogypsum disposal. However, Mosaic was able to maintain substantial if not full downstream production, topping up its rock inventories with imports from Bayovar and OCP while it dealt with legal issues with regard to its Hardee County extension.

The US industry is aiming to concentrate production at the most favourable locations in terms of phosphate rock supply and logistics to domestic and key export markets. This changing role as primarily a domestic market supplier will greatly influence which plants have a future and which will eventually be closed. The primary requirement for survival is an adequate phosphate rock supply. Second to this comes a location from which the main US consumption areas can be accessed. So plants such as Faustina (Mosaic) have a logistical advantage in inland sales, which some of the Bone Valley operations in Central Florida lack. It is worth considering that such a location may make a site attractive even if rock is not locally available — as it has been the case with Pascagoula which relied on imported Moroccan phosphate rock until it closed down in December 2014. For a major international participant, such a plant may offer an ideal gateway to the US market and process local or imported rock, phosphoric acid or simply serve as a terminal cum swing producer of ammonium phosphates. Gypsum storage issues and other environmental factors may work against local production at some factories in the medium to long term, leaving residual value purely in terms of a logistical conduit to the US market, once a site is cleaned up and providing its real-estate value is not too high. On the other hand, the requirements in respect of securing and managing gypstacks once a plant has been permanently shut (close to $100mn) tend to delay permanent closures of sites. The preference has been for an “indefinite idling” — which is occasionally reversed, as happened in a few cases during the recent boom. The following map illustrates the logistical realities of production in the US.

Figure 1-8: North American Ammonium Phosphates Capacity and Logistics



Production is likely to have reached a plateau during the recent period of high fertilizer prices. Weak demand and lower prices saw substantial temporary capacity cutbacks in 2008-09, but this was temporarily reversed in 2010-2011 as phosphate fertilizer prices recovered before falling again in 2012-13. The following table gives an overview of these changes, for the period 2005-13.

Table 1-34: US Production of Processed Phosphates* ***mn t product***

	2005	2006	2007	2008*	2009*	2010	2011	2012	2013
Phosphoric acid (P_2O_5)	10.4	9.4	9.6	7.9	7.3	8.1	8.7	8.0	8.5
DAP	10.0	8.8	7.9	7.3	7.4	7.0	6.6	6.2	5.7
MAP	4.6	4.2	5.3	4.2	3.6	4.6	4.9	4.5	4.5
TSP	0.50	0.22	-	-	-	-	-	-	-

**Includes impact of low utilization rates during 4Q08/1Q09 in response to a sharp fall in global demand and in 2010 the impact of lower production at Mosaic's facilities as a result of the Hardee County legal proceedings.*

— IFA, TFI

The US industry is already switching plants to the products that it can most easily manufacture and which it can best sell domestically and in its favoured export markets. Hidden from the table is the significant growth in production of Mosaic's MicroEssentials NPS+Zn product. The company sold 1.85mn t of MicroEssentials in 2014, up slightly from 1.84mn t in 2013, and accounting for 20pc of total sales (domestic and international) across all products. In 2014, Mosaic produced MES at its Bartow (Florida), Riverview (Florida), and Faustina (Louisiana) phosphate plants, with a total production capacity of 2.3mn t/yr. Mosaic has announced it will continue its strategic priority of expanding its MES capacity with a $225mn investment at its New Wales (Florida) phosphate plant to convert the DAP production lines to MES, with an estimated 1.3mn t/yr capacity to come on stream in 2016-17. This will bring total MES capacity to 3.6mn t/yr by 2017, which will represent almost 30pc of the company's total phosphate fertilizer capacity by then (presumably excluding phosphates capacity from the Ma'aden joint venture).

On the other hand, further permanent capacity closures will occur piecemeal, as and when rock reserves, markets and economics dictate. In the meantime, major producers of phosphate rock such as Mosaic and PotashCorp are trying to consolidate and expand their reserve base to extend the life of their key processing operations — as are smaller producers such as Misschem, Simplot and Agrium. As previously mentioned, PotashCorp has also announced the closure of the Suwannee River phosphoric acid unit at White Springs, but will maintain production at the two granulation units there.

7.1.5. Latin America

The leading producer in Latin America, Brazil, produces monoammonium phosphate, which is a more suitable product for crops such as soybean, which need little or no nitrogen. Even more importantly, the main monoammonium phosphate production facilities are located inland at Uberaba close to the rock mines, where there is no captive ammonia unit. Some of the new monoammonium phosphate units planned are associated with NPK production, which means that monoammonium phosphate capacity tends to be overstated relative to actual production. Planned new capacity is adding a potential 780,000 t/yr monoammonium phosphate to the Brazilian phosphate capacity. The new capacity will consume phosphoric acid produced in Brazil using both local rock and imports. In this respect, the relationship between Vale (the new owner of Bunge's Brazilian production assets) and OCP will be important. In September 2013 OCP acquired full ownership of the phosphoric Acid/MAP/DAP/TSP plant at Jorf Lasfar from Bunge, its previous joint venture partner.

Total monoammonium phosphates capacity in Brazil is assumed to reach 2.2mn t/yr in 2021, following the completion of a 650,000 t/yr expansion project by Anglo American at Catalao, Goias, and with the new Galvani project at Serra do Salitre, Mato Grosso, aiming to produce 130,000 t/yr.

Table 1-35: Growth in Brazilian Monoammonium Phosphate Capacity	*mn t product*
2008	1,325
2009	1,325
2010	1,325
2011*	1,400
2012*	1,475
2013	1,475
2014	1,475
2019	1,475
2020	1,865
2021	2,180

— Argus consulting

The only diammonium phosphate production in Latin America is in Venezuela, where Pequiven expanded capacity in the Moron plant to 450,000 t/yr of DAP/NPK. However, the plant has been running at low utilisation rates due to gas supply issues affecting the ammonia facility. Investment in downstream processing facilities in Peru is possible but unlikely. Mosaic, one of the Bayovar shareholders, is likely to be less interested in a competing ammonium phosphate project and would prefer the Bayovar complex to focus on merchant rock.

7.1.6. Saudi Arabia

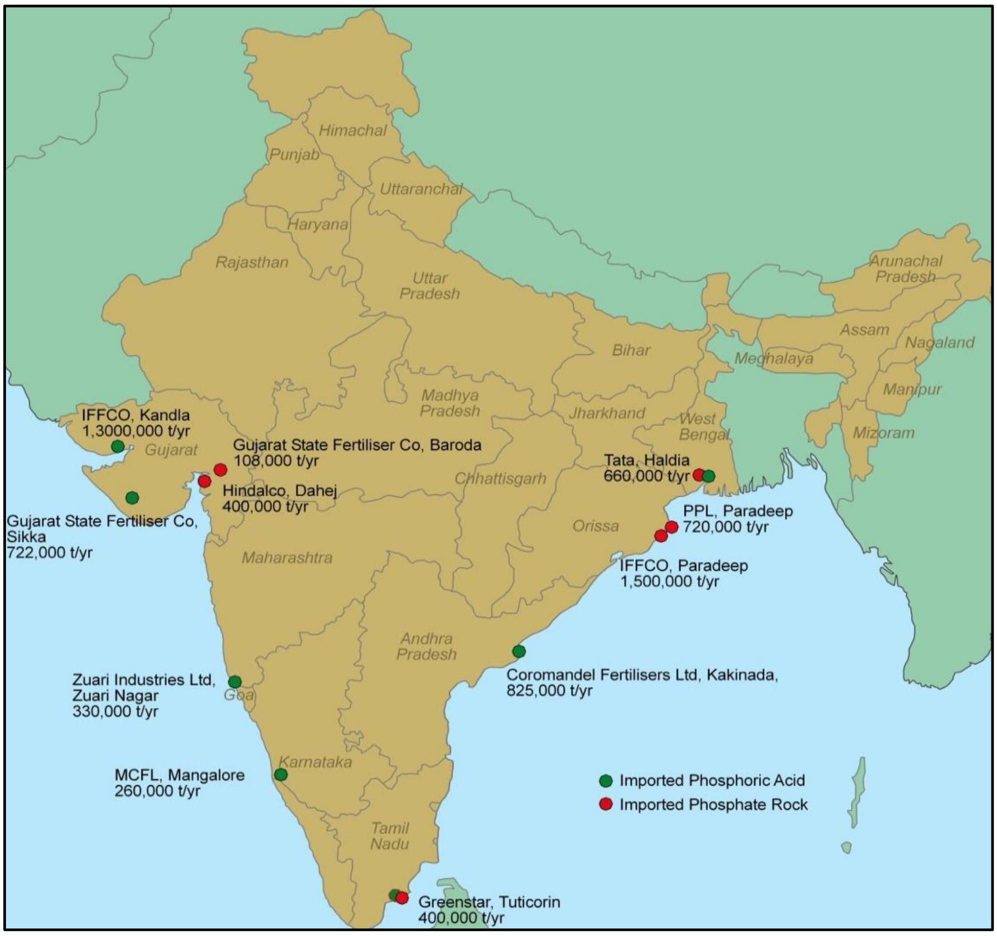
Saudi Arabia started production of ammonium phosphates in 2011 with the start-up of the Ma'aden complex at Ras Al Khair on the east Coast. The processing plant is not yet operating at its full capacity of 2.9mn t/yr because of issues with the rock feed to the acid plant. Total production stood at 2mn t of diammonium phosphate in 2013, and is believed to have reached around 2.4mn t in 2014. In the base case, it was assumed that the plant would only be producing diammonium phosphate, but Ma'aden started producing monoammonium phosphates in 2014 for export to Latin America, with around 120,000t shipped to Brazil, possibly encouraged by a willingness to diversify away from India and potential constraints to diammonium phosphate production arising from the quality of the Al Jalamid rock.

Another major export-oriented investment was announced in 2013, with Ma'aden to form a $7bn joint venture with Mosaic (25pc) and Sabic (15pc) — the Waad Al Shamal phosphate project. This project will involve the development of a new mine in Umm Wu'al in the north of the country (near the actual Al Jalamid mine) where phosphate rock will be beneficiated and processed into phosphoric acid. The acid will then be railed to the existing Ras Al Khair chemical plant which will be expanded to include new downstream capacities for ammonia, ammonium phosphates and NPKs. The project now envisages 1.5mn t/yr of phosphoric acid and 3mn t/yr of fertilizer granulation capacity, which we assume will involve DAP/MAP/NPKs and in all likelihood will include MicroEssential products. Construction has already started and as of the end of December 2014, 14pc of the beneficiation plant, nearly a quarter of the phosphoric acid plant and 18pc of the DAP plant had been completed. We assume these units will come on stream in 2017-18.

7.1.7. Indian Subcontinent

The other focus of strategic planning for the phosphate export industries is the future production and demand of the Indian subcontinent, but most notably of India itself. India currently has the capacity to produce around 8mn t/yr of diammonium phosphate.

Figure 1-9: Indian DAP Capacity by Phosphate Feedstock



There are a number of small expansion projects in India. The broad structure of the Indian ammonium phosphate industry as it stands today is presented in the following table. Capacity is expressed in terms of P_2O_5 since most of the complexes produce diammonium phosphate alongside other NP/NPK compounds. With the introduction of the nutrient-based subsidy system, there has been a significant switch away from diammonium phosphate, for example at IFFCO Kandla.

Table 1-36: Indian Ammonium Phosphates Capacity by Source of Phosphoric Acid *'000t P_2O_5*

Company	Location	On-site Capacity	Imported Acid
Coromandel	Kakinada	-	380
GSFC	Vadodara/Baroda	50	-
GSFC	Sikka		335
Hindalco	Dahej	185	-
IFFCO	Kandla	-	910
IFFCO	Paradeep	690	-
MCFL	Karnataka	-	120
PPL (OCP)	Paradeep	331	
Greenstar (formerly SPIC)	Tuticorin	185	-
Tata	Haldia	305	
Zuari	Zuari Nagar	-	155
Total		**1,746**	**1,900**

— FAI, Argus consulting

After a decade or so of improvement, Indian agriculture has faced a growing imbalance of nutrient usage since the nutrient-based subsidy (NBS) scheme was introduced in 2010. Delays in paying producers and importers the subsidy owing for diammonium phosphate and NP/NPKs are partly to blame along with the high price of 'decontrolled' P and K under the NBS while urea remains heavily subsidised and controlled. The National Democratic Alliance (NDA) government elected in May 2014 appears to have the will to implement policy measures to encourage more P and K use and, in all likelihood, will increase the maximum retail price of urea during 2015. The recent sharp decline in oil prices, with a knock-on impact on LNG feedstock prices, and lower international nitrogen prices provides an environment conducive to make such a shift.

As such, we assume that India will see an expansion in domestic production of diammonium phosphate and NP/NPKs during our outlook period, with some expansions already under way:

- The two large complexes at Paradeep have already been significantly refurbished. IFFCO has achieved greater utilisation of the Paradeep plant that it purchased from Oswal in 2005 and which it has since debottlenecked. This plant now has three production units which can produce DAP, NPKs (10:26:26/12:32:16) and NPs (20:20:0:13/28:28:0). The total capacity is 1.92mn t/yr product, of which 1.5mn t/yr are currently dedicated to DAP. Latest FAI figures for 2014 show production at 590,000t P_2O_5, with 420,000t P_2O_5 used for diammonium phosphate and the remaining 170,000t for NP/NPKs.

  OCP's continuing refurbishment of its Paradeep Fertilizers acquisition has resulted in phosphoric acid production increasing to as much as 425,000t P_2O_5 in recent years compared with nameplate capacity of 331,000t P_2O_5. Latest FAI figures for 2014 show production at 318,000t of P_2O_5, with 190,000t P_2O_5 used for diammonium phosphate and the remaining 128,000t for NP/NPKs;

- Coromandel International plans to expand NPK production at the company's Kakinada complex using new phosphoric acid capacity from the Tifert joint venture with Indian company GSFC and GCT in Tunisia, assuming political problems and supply disruptions in Tunisia are quickly resolved. Tifert phosphoric acid will also allow Coromandel to fully utilise its 1.3mn t/yr NP/NPK plant at Vizag, AP — current production amounts to just over 800,000 t/yr. This additional imported acid will eventually take the total nameplate requirement for merchant acid for ammonium phosphate-based products to 2.1mn t/yr of P_2O_5. There are other compound fertilizer producers that also import phosphoric acid for the manufacture of NP/NPK products;

- In the case of GSFC, the start-up of the Tifert phosphoric acid unit allows the company to achieve full capacity at the existing three DAP lines at Sikka, enabling an expansion in production by 390,000t. In addition, GSFC is considering the construction of a fourth DAP/NPK line at Sikka with a capacity of 500,000 t/yr. GSFC is currently reviewing the detailed feasibility report on this project to arrive at an investment decision. We assume this will move ahead and be completed during 2016, bringing total DAP/NPK capacity to 1.2mn t/yr;

- Kribhco announced in October 2012 that it plans to develop a 1.2mn t/yr P and K fertilizer plant near Krishnapatnam port, Andhra Pradesh. The company has been allocated the land by the state government. However, the project is still at an early stage of development and has not been included in our outlook;

- Zuari is considering a new $743mn, 1.1mn t/yr DAP/NPK plant in Dahej, Gujarat. In a project feasibility report filed by Zuari with the environment ministry, the company has estimated costs of production at 21,570 rupees/t ($356/t as of April 2014) with an ex-works sales price of Rs28,250/t, including a freight subsidy of Rs250/t. There are no recent updates on this project. Zuari also signed an initial agreement with the emirate of Ras Al Khaimah (RAK) in November 2012 to construct a 1mn t/yr integrated DAP facility at the RAM Maritime City Free Zone at a cost of $800mn. It is assumed that the unit would be based on imported ammonia and imported rock from the FosPac rock mining project in Peru of which Zuari is a shareholder and is entitled to lift 1mn t/yr of concentrate. Both projects have gone quiet since 2013 and have not been included in our outlook;

- We assume that 1-2 large-scale expansions in DAP/NPK in India will be constructed in 2020-30. For instance, IFFCO has proposed a major revamp of the three granulation units at Paradeep and the construction of a fourth line that would allow capacity to increase to 3mn t/yr from the current 1.92 mn t/yr. The company's initial intention was to harness rock supplies from an involvement with the Legend phosphate rock project in Queensland, Australia, a project which has now floundered.

The construction of the second Ma'aden complex promises a major and convenient new source of diammonium phosphate in the medium term, and will potentially take production at the site to over 4mn t/yr in the longer term. On the other hand, there is a risk that India will simply exchange its former reliance on US diammonium phosphate for reliance on the Saudi exporter. The new subsidy system in India may limit this risk, as it has widened the range of fertilizer imports that receive subsidies to include both NP and NPK products.

Given that there are no major new merchant phosphoric acid capacity expansions planned, with the exception of the two joint ventures recently put on stream in Jordan (JIFCO) and in Tunisia (TIFERT), future construction of granulation capacity based on acid would result in the concentration of import acid supply in a few hands. As in the past, overdependence on any one form of imported P_2O_5 from any one source is regarded as strategically unsound. Most of the complexes using imported acid have the option of producing other compounds so that they have some built-in flexibility, should imported diammonium phosphate become more readily available at an attractive price. Indian companies are actively searching for offshore joint-venture projects to supply the raw materials that they lack, most notably gas and phosphate rock. The expansion of phosphate fertilizer production using imported phosphate rock represents an important part of their overall supply strategy, but it is proving difficult to achieve. There are concerns about the future supply of acid-quality merchant phosphate rock, particularly as regards new sources of supply. The FosPac joint venture is one of only a few with a realistic chance of supplying acid-grade concentrate (30pc P_2O_5) economically.

7.1.8. China

We have now passed the fourth year in China's 12th Five-Year Plan (2011-15). As one of the major objectives of the Chinese government is to encourage vertical integration in the phosphate sector, it makes sense to look at government policy and subsequent developments across the board from rock to finished product. China's rock sector is fragmented, partly because of the nature of the deposits and partly as a result of the socio-political conditions which pertained during the Maoist era. This fragmentation is logically reflected in the downstream industry. Consolidation in the processing sector is perhaps easier to achieve as most plants and chemical centres ship in rock from a variety of small and medium-scale mines.

In the past each province has supported its older plants while promoting expansion. At the beginning of 2008, there were 105 producers of single superphosphate in Yunnan Province, 70 of which had capacities of less than 100,000 t/yr. This phase of unbridled expansion is coming to an end for both the rock and downstream sectors and the pressure on smaller operations is mounting simultaneously. This is the result of a sea-change in the policies of the Chinese central government's objectives not only for the current plan period but also for subsequent plan periods. On the basis of the 12th Plan policies and provisions, we expect that:

- There will be little or no new capacity built over and above that already under construction or approved;
- Permitting for rock mining will be tightened to squeeze out small mining entities and encourage the amalgamation of adjacent mining areas;
- The efficient beneficiation of lower grades of rock will be mandatory and the practice of skimming off high-grade rock will be discouraged;
- Vertical integration will be encouraged and small non-basic fertilizer plants will be squeezed out of the system;
- Low-analysis products will be squeezed out of the system.

The main objective of the revised strategy is a reduction in the number of participants and an increase in utilisation rates — currently standing at an industry average of about 70pc — at efficient operations throughout the industry. The government has a range of levers to encourage greater efficiency, but the basic tools are subsidies on the one hand and penalties on the other:

- Environmental considerations will play an increasing role, for example, the introduction of a staged reduction in fluorine emissions;
- The government has introduced fees on the discharge of wastes and a rising tax on natural phosphogypsum. The threat is that Beijing will simply close down polluting industries. In the first half of 2012, one plant was given a large penalty for land and water contamination from a phosphogypsum stack, which occurred in 2008. The company had failed to

implement basic protective measures such as the use of underlying plastic ground-sheeting;

- In 2008, the government raised the royalty payable on rock produced to 15 yuan/t. Hubei province unilaterally introduced a flat 10pc payment on all grades in January 2013;
- Higher energy costs have hit all sectors, but particularly energy-intensive industries such as yellow phosphorus production, for which 14,000 kWh/t are required per tonne;
- Among the most important levers used by both central and provincial governments are value-added tax (VAT) and the power and rail tariff structure.

The central government and provinces are able to use more direct measures to rationalise the industry. In 2008, Yunnan Province began to phase out preferential rail tariffs for small-scale, single superphosphate producers which had hitherto been supplied from the nearest source of phosphate rock at preferential prices. As from March 2008, rail cars were not allocated to producers with a capacity below 100,000 t/yr. This has since been upwardly adjusted so that by 2010, rail cars were no longer allocated to producers with a capacity of less than 200,000 t/yr.

In Hubei, the provincial restructuring plan had the objective of rationalising the industry by reducing the number of fertilizer producers by 30pc by 2015 while phasing out small-scale operations by the end of 2014:

- Sulphuric acid plants with capacity below 100,000 t/yr;
- Compound fertilizer plants with capacity below 50,000 t/yr;
- Single superphosphate and FCMP plants with capacity below 100,000 t/yr;
- Ammonium phosphate plants with less than 15pc capacity utilization;
- Phosphoric acid plants with capacity of less than 60,000 t/yr P_2O_5.

Measures aimed at small-scale operators, environmentally unfriendly industries and producers of low-analysis products have generally been put into place during the course of the five-year plan period, although closures have not proven sufficient to offset growth in high-analysis fertilizer production.

The China Phosphate Fertilizer Industry Association (CPIA) estimates that China's total phosphate and compound fertilizer capacity stood at 23.5mn t/yr P_2O_5 as of the end of 2014, of which DAP capacity was estimated at 19.5mn t/yr (t product) and MAP capacity at 17.5mn t/yr (t product). The following chart and table summarise the development of high-analysis phosphate fertilizer capacity since 2005 and projects that are already in hand or received licences in the last plan period. Please note that capacity listed as DAP may ultimately produce MAP or other NP/NPKs. We have also used 44pc as the P_2O_5 content of MAP which seems to be the Chinese industry norm, and 16pc as the P_2O_5 content of NPKs.

Figure 1-10: China Incremental High-Analysis Phosphate Fertilizers Capacity, 2005-16

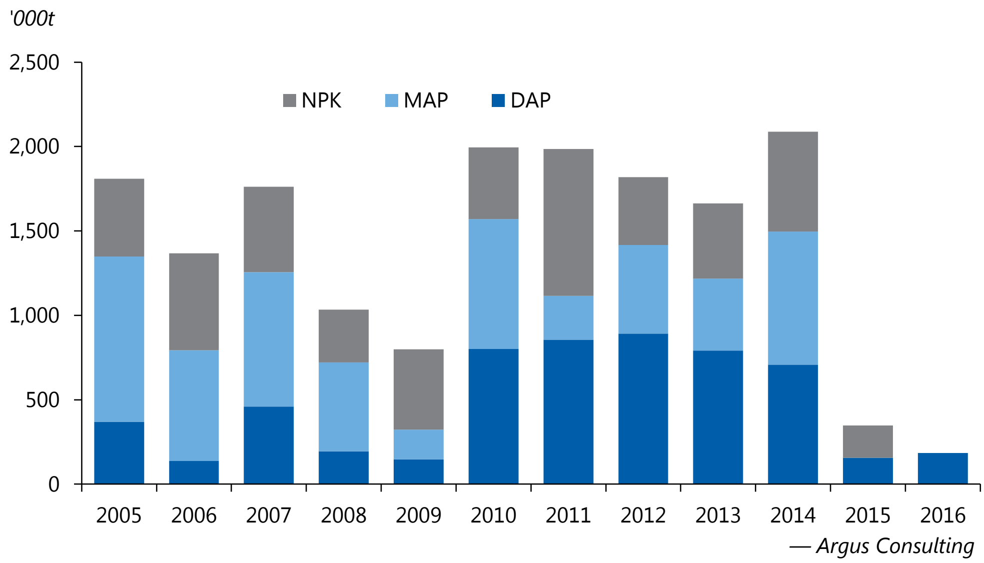


Table 1-37: China Incremental High-Analysis Phosphate Fertilizers Capacity, 2005-16												'000t P_2O_5
	2005	**2006**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Total Capacity Increment	**1,809**	**1,368**	**1,762**	**1,033**	**799**	**1,994**	**1,986**	**1,818**	**1,664**	**1,956**	**480**	**184**
DAP	368	138	460	193	147	800	856	892	791	708	156	184
MAP	981	656	796	528	176	770	260	524	427	656	132	-
NPKs	460	574	506	312	476	424	870	402	446	592	192	-
												—Argus consulting

According to CPIA, China produced 17.1mn t P_2O_5 of phosphate fertilizer in 2014, up by 3.7pc compared with 2013 — of which 13.76mn t (80pc) were claimed to be high-analysis fertilizers. It would be a mistake to ignore the contribution of low-analysis phosphate fertilizers to total supply. The following table gives a picture of recent developments in the Chinese phosphate fertilizers sector as a whole:

Table 1-38:China Phosphate Fertilizer Production, 2010-14						'000t P_2O_5
Product	**2010**	**2011**	**2012**	**2013**	**2014**	**Change 2010-14**
DAP/MAP	10,751	12,350	12,867	12,495	13,342	+2,591 (+24pc)
TSP	782	1,081	662	400	420	-362 (-46pc)
NPK	1,370	1,500	1,280	1,694	1,700	+330 (+24pc)
Other NPs	110	115	60	NA	44	-66 (-60pc)
SSP	2,600	2,200	1,950	1,681	1,601	-999 (-38pc)
FMP	250	250	250	NA	NA	NA
Ground phosphate rock (direct application)	135	135	140	NA	NA	NA
Total P_2O_5	**15,998**	**17,631**	**17,209**	**16,490**	**17,107**	**+1,109 (+7pc)**
						-IFA, CPIA

We can see from this table that:

- The pressure on new production is mainly to be seen in the ammonium phosphates sector;

- The growth in NPK production was strong, while other NPs production collapsed, largely as a result of the poor quality of products based on ammonium chloride.

- Fused magnesium phosphate and ground phosphate rock have become minor products. There is a possibility that fused magnesium phosphate will have some role in the future, but not in the old, small-scale and dirty operations which remain. The slagging process is an established route to the production of a fertilizer that can use poor quality rock but also contains calcium and magnesium. Against this, the main grades on sale contain 14pc P_2O_5 and 16pc P_2O_5. FMP may yet gain favour, as and when the value of the other secondary nutrients is recognized and new, environmentally friendly and energy efficient units are developed.

- Single superphosphate and triple superphosphate are the main losers and this suggests that the policy of closing small-scale low-analysis plants is working. Looking at market reports in China, it is clear that a great deal of the single superphosphate sold is of two grades — 12pc P_2O_5 and 14pc P_2O_5. Such products are manufactured using run-of-mine ore with 20-23pc P_2O_5 content.

In terms of distribution of phosphate fertilizer production across China, reports indicate that the output of the top five producing provinces — Hubei, Yunnan, Guizhou, Sichuan and Anhui — accounted for 79pc of China's total phosphate and compound fertilizer production in 2014.

China's top five DAP producers were Yuntianhua International (YTH) (3.46mn t product), Kailin (2.32mn t product), Wengfu (1.84mn t product), Yihua (1.35mn t product) and Xianfeng (0.93m t product), and their combined 2014 DAP production comprised 65pc of the country's total. With regards to MAP, China's top five producers were Yuntianhua International (1.34mn t product), Hubei Yangfeng (1.25mn t product), Hubei Xiangyun (1.05mn t product), Anhui Sier'te (0.64mn t product) and Sinochem Chongqing Fuling (0.63mn t product), and their combined 2014 MAP production accounted for 41pc of the country's total MAP output.

Recent reports also indicate that the number of compound fertilizer producers in China has decreased from the peak of 4,400 to 3,400 in 2014, while the number of China's SSP or FMP producers has decreased from over 1,100 to 700.

The next national plan is likely to continue the path of rationalisation and increased efficiency. We expect the authorities to construct more chemical parks to force the closure of old, small-scale, polluting, non-integrated plants, especially those producing low-analysis fertilizers. Many smaller producers will be given an invitation they cannot refuse to move their old facilities to these parks, where all aspects of production can be monitored. The environmental protection challenges will be of particular importance. Phosphogypsum is already a source of concern — fines are being imposed for leakages of effluent into the water and the new plan decrees that the focus is now on finding uses for phosphogypsum rather than simply stacking. China's Phosphate Fertilizer Industry Association estimates that the country has over 300mn t of phosphogypsum stacks, while 70mn t of phosphogypsum is generated annually, of which 51mn t is discharged as a waste product while only 19mn t is used as cement retarder, construction material, raw material for chemical products, soil conditioner or other purposes. We expect that the forthcoming five-year plan may impose a mandatory requirement to process a proportion of gypsum, with a target of 40pc utilization of the phosphogypsum by 2020. In order to prepare the way, the national government has already imposed a tax on natural gypsum in order to encourage the use of phosphogypsum. We expect a significant attrition rate as plants lose their licences to produce on the grounds of environmental performance or scale of production, but are not in a position to transfer operations to a chemical park. However, progress will remain uneven:

- While some of the phosphate-rich provinces have more advanced industries than others, the picture is not uniform within any province. Large-scale production sites co-exist with old, small-scale units, which will be closed, allowing the large production centres to expand;

- Phosphate-rich provinces are being given every encouragement to pursue vertical integration. The elimination of smaller mining and processing competitors within each of these provinces allows the large companies to expand at their expense. The tonnage limits being set on the sale of high-grade rock and rising prices will gradually remove many of the non-basic producers — even more efficient companies. For example, rock produced in the rich Yichang mining areas goes mainly to supply Yihua Group, while the rock produced in Xiaogan areas and north of the Huangang area goes to Huangmailing Chemical. A reduction in the volume of phosphate rock transported would be a welcome development in light of the chronically-stressed transport infrastructure;

- Transport will remain an issue well beyond the end of the current plan period. Most producers are located in the southwest, far from the markets, and would face increasing production costs if the country's rail freight rates were to increases further. Two of the most important phosphate-rich provinces — Guizhou and Yunnan — are located on the interior plateau, almost 1,000km from the nearest port and difficult for internal shipments. As non-basic plants close, both in and outside of the main rock-producing areas, there may be some increase in the small-scale importation of phosphate fertilizers, particularly into the north of the country, to ensure smooth supply. As rock supply tightens and seasonal stockpiles become smaller, the case for importing some phosphate may grow stronger, especially as the rainy season is so disruptive to transport internally.

Four years into the current Plan Period and we can begin to assess whether the government intentions are being put into practice. The policies on phosphate rock and fertilizers are moving hand in hand. Throughout 2013 and 2014, the recurrent theme has been of local government "limitations" on the production of smaller operations. The objectives of the current plan include a capacity total for phosphate fertilizers of 22mn t/yr P_2O_5, down from the 23.5mn t/yr P_2O_5 estimated in 2013, and output of 16mn t/yr P_2O_5. This is in line with current capacity utilisation rates of about 70pc. According to CPIA, the number of phosphate fertilizer producers has already decreased to about 330, and is expected to decrease further to around 150 in the next five years.

There is a further driving force that we expect to strongly influence the strategic shape of the new plan period (2016-20), namely the rapid deterioration of rock quality and the difficulties of beneficiating much of the ore into a concentrate suitable for the manufacture of phosphoric acid and ammonium phosphates. Overall, we believe that there are sufficient reserves of rock in China to supply the fertilizer industry for the foreseeable future. The main problems are:

- The deposits are fragmented and worked by many hundreds of small (less than 300,000 t/yr rock) and medium-sized enterprises (less than 1.5mn t/yr rock). There are few larger mines relative to the total output of the industry. We have identified eight mines with production of roughly 2mn-3mn t/yr rock and three with output above this. The three large players are larger corporation operations working on a number of mines, often in different areas so the total represents the total of several mines;

- Many of the smaller mines still represent serious safety and environmental risks;

- Less than 40pc of ore is beneficiated and often beneficiation amounts to crushing and sometimes washing;

- High quality rock ($\geq$30% P_2O_5) is rapidly being depleted so effective beneficiation of lower grade ores is becoming the priority. Many of the ores contain a cocktail of impurities that are difficult to remove.

As we have seen above, the excessive investment in processing will have been curbed by the end of the current Five-Year Plan Period. The problem for the next two Plan Periods is the development of rock of a suitable grade and quality to serve the existing capacity. The impact of the overall deterioration in rock quality suggests that:

- Production of processed P_2O_5 is likely to peak in the current plan period and will thereafter plateau for some time at best;

- The problem of under-specification products will increase as rock quality decreases;

- An awareness that the industry is exporting its rapidly declining resources of high-quality rock in the form of high-spec ammonium phosphates will influence government policy. It contradicts long-standing efforts to replace lower analysis products with high-analysis fertilizers on the domestic market.

7.1.9. Oceania

The Australian industry, dominated by Incitec Pivot (IPL), is facing important challenges that could negatively affect costs and long-term viability. IPL operates a 1mn t/yr DAP/MAP plant in Phosphate Hill near Mount Isa in Queensland. IPL currently produces sulphuric acid at the plant from processing metallurgical gas sourced from Glencore/Xstrata's copper smelter and from burning imported elemental sulphur. Following Xstrata's copper smelter planned closure in 2016, the IPL plant will have to import sulphuric acid and bring it inland to compensate, as IPL has no intention of building a new sulphur burner. This means that the company will become increasingly reliant on imported sulphuric acid, which will hike production costs. IPL also recently announced that higher gas costs at Phosphate Hill from

February 2015 will have a negative cost impact. This then raises the question of the long-term viability of the plant from 2020 onwards.

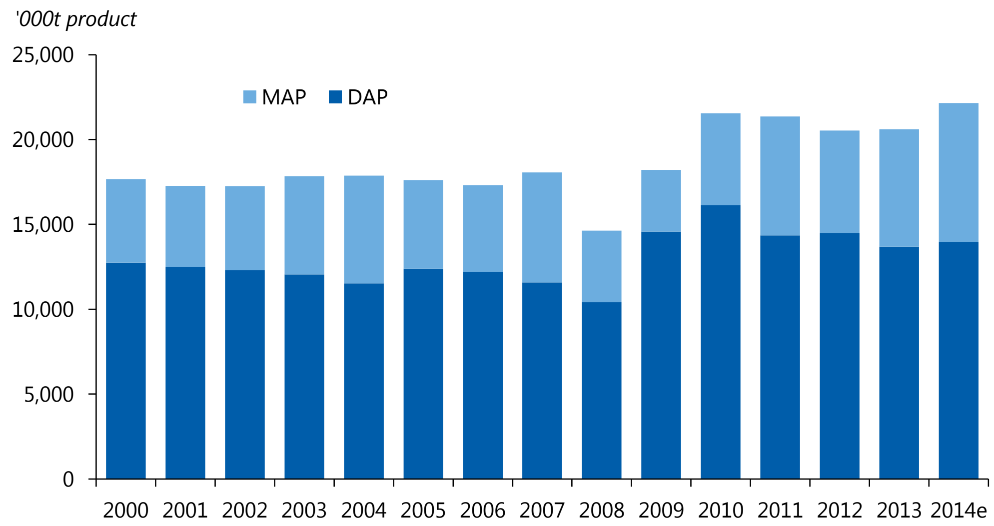
IPL was considering a major expansion during the 2007-08 market peak (a smaller expansion was completed in 2010). Like a number of other inland producers, there are additional difficulties in moving forward with such a project:

- Availability of piped gas at the site;
- Sulphuric acid availability after the closing of the adjacent Mount Isa copper smelter;
- Transportation of additional volumes of sulphuric acid or sulphur from the coast;
- Transportation of phosphoric acid to the coast in the event of gas feedstock not being available or alternatively the movement of ammonia to the site.

IPL has ruled out production of triple superphosphates on the grounds that investment should be based on sound market prospects and not production constraints.

7.2. Trade in Ammonium Phosphates

Figure 1-11: Ammonium Phosphates Trade, 2000-14



— *IFA*

The restructuring of trade versus production has defined the last decade in the ammonium phosphates market. Monoammonium phosphate has shown strong growth in both production and exports (up by 40pc since 2000). Diammonium phosphate production and trade have grown less as some major industries have encountered problems meeting specification and have opted for monoammonium phosphate production. The switch to monoammonium phosphate suits most phosphate manufacturers because it reduces the use of imported ammonia and maximises the P_2O_5 content of the export product. At the same time, the production of merchant acid and triple superphosphate has not changed greatly.

Excluding the sharp contraction in 2008, total trade in mainstream ammonium phosphates in 2000-09 was relatively stable, fluctuating between 17.2mn-18.2mn t/yr, or 8.1mn-8.7mn t of P_2O_5. In contrast, 2010-11 saw a sharp increase in ammonium phosphates trade to 21.4mn-21.5 mn t (around 10.2mn t of P_2O_5), driven by surging demand from Latin America and India. Trade fell slightly in 2012 and 2013 to 20.5mn t and 20.6mn t, respectively, and recovered by around 2mn t to 22.6mn t in 2014 — with most of the growth captured by monoammonium phosphates.

Taking the 2010-11 peak, 10.2mn t of P_2O_5 ammonium phosphates trade compares with 4.7mn t of P_2O_5 merchant phosphoric acid and 1.8mn t of P_2O_5 triple superphosphate and less than 200,000t of P_2O_5 single superphosphate. Trade in NP/NPK products other than ammonium phosphates is estimated at around 2mn-2.5mn t of P_2O_5, but a small part of this would comprise cross-border shipments of products blended or compacted using traded ammonium phosphates.

As the major source of world trade in P_2O_5 — ammonium phosphates penetrate every region and the overwhelming majority of markets. The most significant feature of recent trade patterns has been that, while the overall volume of trade in ammonium phosphates has scarcely changed during most of the first decade of this century, there has been a major shift in the pattern of trade since 2010-11. The following tables give an overview of these changes, for the period 2000-13:

Table 1-39: Major Exporters of Diammonium Phosphate *'000t product*

	2000	2008	2009	2010	2011	2012	2013
World	**12,751**	**10,415**	**14,583**	**16,131**	**14,358**	**14,474**	**13,689**
of which							
Lithuania	564	714	889	810	822	740	810
Russia	1,307	1,595	2,012	1,955	1,243	1,213	889
USA	7,007	4,102	5,202	4,210	3,683	3,068	2,935
Morocco	1,271	599	1,295	1,860	1,990	2,046	1,397
Tunisia	1,014	854	1,144	1,157	354	559	633
Saudi Arabia	-	33	-	30	432	1,354	1,875
Jordan	460	637	659	792	731	545	565
China	204	817	2,073	3,988	4,018	3,934	3,820
Others	924	1,064	1,309	1,328	1,086	1,015	765

— *IFA/Argus Consulting*

Table 1-40: Major Exporters of Monoammonium Phosphate							***'000t product***
	2000	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**
World	**4,918**	**4,217**	**3,635**	**5,418**	**7,000**	**6,042**	**6,916**
of which							
Russia	1,957	1,235	896	1,455	2,193	1,669	2,000
US	2,194	1,327	1,419	1,613	1,862	1,533	1,753
Morocco	341	348	467	851	1,158	1,610	1,654
China	94	1,016	496	935	765	526	627
Others	332	291	357	564	1,022	704	882

— IFA/Argus Consulting

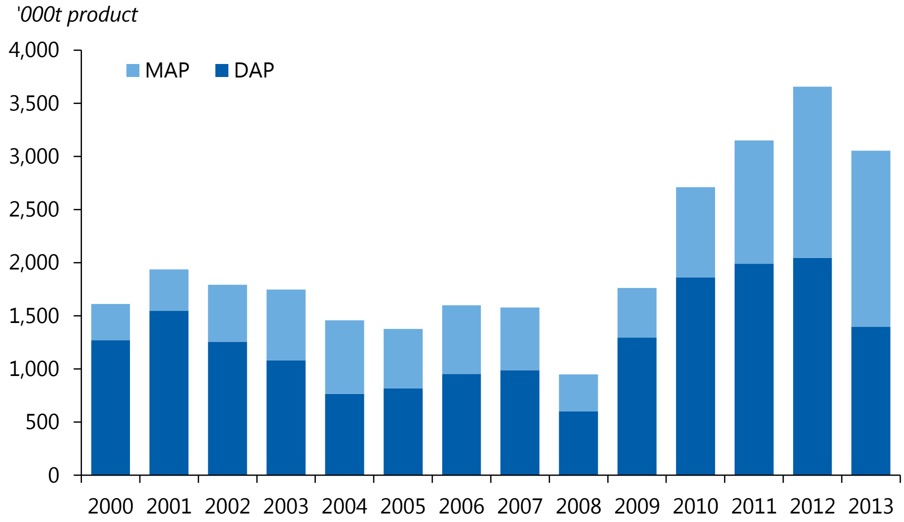
The following points emerge from these tables:

- As mentioned above, the expansion in monoammonium phosphate has limited overall growth in diammonium phosphate exports, partly the result of consumer choice, and partly producer availability;

- China has ceased to be the world's largest importer of ammonium phosphates, and has become a major exporter in its own right. Production growth in China has freed up the tonnage it used to import for sale throughout the world's deficit markets. Taking the period 2000-13 total Chinese deliveries rose by 22mn t, domestic deliveries by 17.8mn t and export deliveries by 4.1mn t. Over the same period imports fell by 3.9mn t/yr so the net trade swing in trade has been 8mn t. Chinese exports of diammonium phosphate and monoammonium phosphate reached a record of 4.9mn t and 2.3mn t, respectively, in 2014, with the country overtaking the US as the world's largest exporter in terms of P_2O_5. This growth has occurred despite the narrowing of the export tax window for Chinese exports, as explained later in this report;

- Since 2008, Morocco has seen a significant increase in exports of ammonium phosphates with diammonium phosphate exports reaching just over 2mn t in 2012, before falling to 1.4mn t in 2013 on the back of weaker Indian demand, while monoammonium phosphates exports reached almost 1.7mn t in 2014;

Figure 1-12: Moroccan DAP and MAP Exports



— *IFA/GTIS*

- Saudi Arabia started exporting ammonium phosphates in 2010, with the start-up of the Ma'aden complex at Ras Al Khair on the east Coast. The processing plant is still ramping up to its full capacity of 2.9mn t/yr because of issues with the rock feed to the acid plant. In 2013 diammonium phosphate exports stood at nearly 1.9mn t and are believed to have reached 2.3mn-2.4mn t in 2014. In the base case, it was assumed that the plant would only be focusing on diammonium phosphate, but Ma'aden started producing and exporting monoammonium phosphates in 2014 for export to Latin America, with around 115,000t shipped to Brazil, possibly encouraged by a willingness to diversify away from India and potential constraints to diammonium phosphate production arising from the quality of the Al Jalamid rock;

- Export deliveries of ammonium phosphates from the US almost halved over the last decade — to 4.7mn t in 2013, compared with 9.2mn t in 2000. But domestic deliveries increased by 700,000t between 2005 and 2013. Overall, total deliveries were down by around 4.4mn t. The higher domestic delivery figures for 2012 were supported in large part by biofuels and strong grain prices, but have declined in 2013 and 2014;

Table 1-41: US Domestic Deliveries vs. Exports of Ammonium Phosphates				*mn t product*
	Domestic deliveries		Export deliveries	
	MAP	DAP	MAP	DAP
2005	2.1	3.7	2.4	6.4
2006	2.5	3.5	1.9	5.7
2007	3.2	3.8	1.9	4.1
2008	2.4	2.7	1.3	4.1
2009	2.6	2.8	1.4	5.2
2010	2.9	2.9	1.6	4.2
2011	2.8	2.8	1.9	3.7
2012	3.0	3.1	1.5	3.0
2013	2.7	2.8	1.8	2.9
				— IFA/TFI

- Fluctuations in domestic demand have a direct impact on export deliveries. For decades the US industry was the global swing producer of ammonium phosphates and adjusted its output to cope with market fluctuations. It has now become a major contributor to those fluctuations, leaving the North African industry — notably Morocco — to tailor output to market circumstances. Declining production of diammonium phosphate is expected to reduce export availability in the near future.

Overall, the import market for ammonium phosphates has a much wider base than that for superphosphates. It represents the best value for money for importers and is ideal for the blending market that now dominates compound fertilizer manufacture in large areas. The following tables show the spread of global import activity and the destinations to which the incremental volume, freed by changes in China, is being delivered.

Table 1-42: World Diammonium Phosphate Imports							'000t product
	2007	2008	2009	2010	2011	2012	2013
World	**11,580**	**10,417**	**14,582**	**16,131**	**14,358**	**14,473**	**13,684**
West Europe	**1,828**	**863**	**1,533**	**1,608**	**1,307**	**1,715**	**2,342**
France	503	238	223	419	229	299	370
Germany	185	79	251	176	185	208	368
Italy	368	149	264	275	175	301	249
Spain	122	35	277	92	65	115	263
Other	650	362	518	645	653	792	1,092
East Europe/ Central Asia	**333**	**178**	**463**	**437**	**277**	**407**	**499**
Turkey	325	178	430	371	218	391	480
Other	8	0	33	66	59	16	19
Africa	**530**	**508**	**919**	**761**	**740**	**1,010**	**896**
Ethiopia	254	283	495	372	323	588	295
Kenya	100	136	136	136	146	118	258
Other	176	90	288	253	271	304	343
North America	**97**	**91**	**105**	**331**	**336**	**265**	**319**
US	93	88	97	119	129	180	80
Canada	4	3	8	211	207	85	239
Unspecified	-	-	0	0	-	-	-
Latin America	**2,465**	**1,233**	**1,128**	**1,695**	**1,855**	**2,100**	**2,071**
Brazil	668	415	318	508	534	687	668
Argentina	513	226	135	244	284	311	307
Mexico	348	145	145	229	210	224	214
Chile	124	93	-	-	-	51	-
Other	812	354	531	715	826	827	882
Middle East	**262**	**144**	**271**	**277**	**82**	**98**	**253**
Iran	249	144	218	247	63	3	61
Other	13	1	53	30	19	95	192
South Asia	**3,752**	**5,906**	**7,431**	**8,768**	**8,008**	**6,723**	**4,888**
India	2,530	5,579	6,339	7,828	6,941	5,868	3,720
Pakistan	1,214	303	880	650	504	493	800
Other	8	24	212	289	564	362	367
Southeast Asia	**1,177**	**678**	**1,391**	**1,242**	**1,044**	**1,260**	**1,399**
Thailand	389	256	252	444	459	559	511
Vietnam	635	258	932	603	492	432	577
Other	152	165	207	195	93	269	311
East Asia	**804**	**467**	**991**	**571**	**313**	**513**	**729**
China	401	96	738	211	-	198	272
Japan	357	351	218	299	283	312	396
Other	46	21	35	60	30	3	61
Oceania	**302**	**341**	**349**	**416**	**305**	**346**	**-**
Australia	208	268	224	248	163	195	160
New Zealand	85	72	122	164	142	151	116
Other	4	2	-	4	-	-	-
Unspecified	**35**	**-**	**4**	**0**	**-**	**36**	**3**
							— IFA

Table 1-43: World Monoammonium Phosphate Imports							'000t product
	2007	2008	2009	2010	2011	2012	2013
World Total	**6,482**	**4,207**	**3,620**	**5,433**	**6,998**	**6,042**	**6,913**
West Europe	**869**	**329**	**243**	**321**	**417**	**510**	**608**
East Europe/ Central Asia	**287**	**270**	**348**	**387**	**509**	**379**	**500**
Africa	**82**	**67**	**71**	**74**	**168**	**145**	**165**
North America	**698**	**548**	**460**	**671**	**1,029**	**943**	**1,063**
Canada	658	423	389	352	563	466	569
US	40	124	70	319	465	478	494
Latin America	**3,051**	**1,699**	**1,556**	**2,640**	**3,395**	**3,084**	**3,634**
Brazil	1,871	1,052	875	1,645	2,312	2,044	2,777
Argentina	619	270	348	570	576	622	439
Mexico	176	82	83	82	54	86	78
Uruguay	101	71	50	78	87	64	109
Chile	106	73	51	75	72	51	73
Colombia	128	76	55	123	151	148	104
Other	49	76	94	65	143	69	53
Middle East	**31**	**8**	**11**	**9**	**10**	**32**	**11**
South Asia	**481**	**336**	**283**	**332**	**528**	**215**	**75**
India	315	287	251	255	449	200	57
Other	165	49	31	76	78	15	18
Southeast Asia	**344**	**263**	**99**	**140**	**63**	**41**	**58**
East Asia	**177**	**144**	**121**	**150**	**122**	**152**	**139**
Oceania	**463**	**425**	**382**	**551**	**597**	**478**	**518**
Australia	453	414	382	537	547	478	518
New Zealand	10	11	-	14	50	-	0
Unspecified	**-**	**18**	**48**	**159**	**160**	**62**	**144**

— IFA

Table 1-44: DAP Trade Matrices, 2013 *'000t product*

	Exporter									
	US	China	Russia	Morocco	Tunisia	Lithuania	Jordan	Saudi Arabia	Other	Total
World Total	**2,935**	**3,819**	**889**	**1,394**	**631**	**810**	**565**	**1,875**	**767**	**13,684**
Europe	**-**	**6**	**544**	**644**	**555**	**705**	**213**	**76**	**97**	**8,841**
Africa	**38**	**33**	**112**	**188**	**55**	**9**	**103**	**344**	**13**	**896**
North America	**77**	**-**	**1**	**195**	**-**	**31**	**-**	**-**	**15**	**319**
Latin America	**1,595**	**13**	**40**	**203**	**18**	**22**	**-**	**55**	**126**	**2,071**
Argentina	250		5	35		17			-	307
Brazil	451			162				55	0	668
Other Latin America	893	35	35	5	18	5	-	-	126	1,095
Middle East	**-**	**63**	**-**	**2**	**3**	**-**	**116**	**69**	**-**	**253**
South Asia	**702**	**2,632**	**-**	**37**	**-**	**43**	**131**	**1,091**	**253**	**4,888**
India	702	2,009					131	879	-	3,720
Pakistan		475		37		43		159	85	800
SE Asia	**82**	**815**	**186**	**30**	**-**	**-**	**0**	**175**	**110**	**1,399**
East Asia	**344**	**184**	**1**	**85**	**-**	**-**	**-**	**64**	**51**	**729**
Oceania	**97**	**74**	**-**	**9**	**-**	**-**	**-**	**-**	**99**	**279**
Unspecified	**-**	**-**	**6**	**-**	**-**	**-**	**1**	**-**	**3**	**9**

— IFA

Table 1-45: MAP Trade Matrices, 2013 *'000t product*

	Exporter					
	US	Russia	China	Morocco	Other	Total
World Total	**1,749**	**2,000**	**640**	**1,655**	**869**	**6,913**
Europe	**-**	**886**	**1**	**131**	**90**	**1,107**
Africa						**165**
North America	**-**	**99**	**18**	**46**	**1**	**1,063**
Canada	567	-	-	-	2	569
United States	-	201	-	244	48	494
Latin America	**848**	**800**	**466**	**1,227**	**294**	**3,634**
Argentina	182	140	37	18	62	439
Brazil	426	613	390	1,186	162	2,777
Other Latin America	240	46	39	23	70	418
Middle East	**-**	**8**	**3**	**-**	**-**	**11**
South Asia	**-**	**-**	**69**	**7**	**-**	**75**
Southeast Asia	**8**	**1**	**49**	**-**	**-**	**58**
East Asia	**110**	**1**	**28**	**-**	**-**	**139**
Oceania	**217**	**-**	**7**	**-**	**294**	**518**
Unspecified	**-**	**5**	**-**	**-**	**139**	**144**

— IFA

The following regional picture emerges from these tables:

Western Europe

The region generally takes about 2mn-3mn t/yr of ammonium phosphates (DAP and MAP combined), although volumes were much reduced in 2008 (1.3mn t). In 2013, western Europe's imports stood at almost 3mn t, the highest level recorded since 2005. The central European countries in the region retain their traditional preference for monoammonium phosphate, and the western countries for diammonium phosphate — which makes sense in respect of delivery logistics. Throughout the region, the volume of deliveries reflects the size of the blending market, since ammonium phosphates are generally used in blends. This indicates a blending volume of about 6mn t/yr. Unit nutrient cost is the key to the purchasing pattern of blenders — they will take any of the concentrated phosphate fertilizers, including NPKs, at the right price. This focus on cost means that western European countries tend to take diammonium phosphate from North Africa and Lithuania, and central European countries take monoammonium phosphate from Russia and Ukraine.

East Europe and central Asia

The region imported 1mn t of ammonium phosphates in 2013. Excluding Turkey, trade in this region is limited and restricted to the traditional Soviet product — monoammonium phosphate. A number of reasons explain the limited trade volume, most importantly the slow recovery in agriculture. There are also a number of smaller producers of monoammonium phosphate in the region. Kazakhstan and Uzbekistan produce 10-46-0 based on local rock and both countries are looking for an opportunity to develop their industries. Ukraine and Belarus are the largest importers of monoammonium phosphates, while depending on purchased rock to support their downstream industries, and so are unlikely to expand. On the other hand Turkey is the largest importer of diammonium phosphate in the region, with 480,000t imported in 2013, the highest level recorded since 2006. According to the latest statistics published by GTIS, diammonium phosphate imports stood at 423,000t in 2014, mainly sourced from Jordan, Tunisia Russia and Saudi Arabia.

North America

The region imported 1.4mn t of ammonium phosphates in 2013, of which more than 75pc was monoammonium phosphate. The biggest increase was seen in shipments of monoammonium phosphate to the US which amounted to 500,000t in 2013, more than 12 times the volume imported in 2007. Shipments of Russian and Moroccan ammonium phosphate into the US east coast are now a feature of the market, and as the US industry declines, growth in finished fertilizer imports is expected to continue. The trend of higher imports continued in 2014 with monoammonium phosphate imports up 45pc year on year (January to November). The bulk of the imports were sourced from Morocco (down by 19pc), followed by Russia (up by 73pc) and China (around 140,000t versus nothing in 2013). Last year also marks the start of an arrangement between PotashCorp (PCS) and Morocco's OCP whereby OCP ships phosphate to PCS and PCS ships ammonia ex-Trinidad and Tobago to OCP.

Latin America

Large volumes of monoammonium phosphate and diammonium phosphate are imported by Latin American countries. The US industry still accounts for almost 45pc of ammonium phosphate exports into Latin America. But Russia and Morocco have become the leading suppliers of monoammonium phosphate into the region, with Morocco overtaking the US in 2013. Brazil accounted for 60pc of the region's ammonium phosphates imports in 2013, with a large preference for monoammonium phosphate (80pc of total imports). According to the latest statistics published by GTIS, 2014 Brazilian MAP imports hit 3mn t, up by 20pc year on year. The most notable development has been the diversification of supply sources in 2014. Russian suppliers have gained most, upping shipments by 37pc, mostly at the expense of OCP which has seen tonnage slip by 30pc. US suppliers have doubled their shipments but the greatest increase has been in various grades of Chinese MAP (440,000t imported from China). Saudi producer Ma'aden has also moved close to 120,000t of MAP to Brazil for the first time ever. Heightened competition and imports of low-grade MAP (11-44 and 10-50) are expected to continue in 2015.

Table 1-46: Latin American Ammonium Phosphate Imports by Source, 2013 *'000t product*

	US	Russia	China	Morocco	Other	Total
MAP	426	613	390	1,186	162	**2,777**
DAP	451			162	55	**668**
Total	**877**	**613**	**390**	**1,348**	**217**	**5,184**
Share	*25%*	*18%*	*11%*	*39%*	*6%*	*100%*

— IFA

In 2014, Brazil announced the suspension of the 6pc duty on diammonium phosphate with less than 6ppm arsenic. This will open up the Brazilian market to competition from outside the US, which accounted for 68pc of DAP imports in 2013. Russia's PhosAgro has already announced plans to increase its exports to Brazil in response. The duty cut could also benefit exporters looking to diversify from the slow Indian DAP market and perhaps, more immediately, those looking to expand their existing presence in Brazil. Morocco's OCP, Brazil's second-largest DAP supplier responsible for 29pc of imports, is looking to enhance its local distribution after taking a 10pc stake in Brazil-based Fertilizantes Heringer SA in June, two months after US firm Mosaic purchased ADM's Brazil fertilizer distribution business.

Africa

A total of 16 African countries import ammonium phosphates but none of the tonnages are significant in global terms. On the other hand there has been a surge in diammonium phosphate imports since 2009, reflecting an improving outlook and interest in the region's agricultural sector. Ethiopia is the leading importer, taking 300,000-590,000 t/yr in 2009-13. The most recent development was a switch from diammonium phosphate to NPS in the August 2014 tender, when Ethiopia cancelled the initial 100,000t diammonium phosphate tender and upped its requirements for 19-38-0+7S to over 500,000t for delivery November 2014-June 2015. This tender was dominated by OCP (350,000t) and PhosAgro (over 150,000t), mostly at the expense of Middle East producers as Ethiopian diammonium phosphate requirements have traditionally been met by Saudi Arabia and Jordan. Kenyan diammonium phosphate imports rose to 260,000t in 2013, around double the 130,000-150,000t imported in recent years. The purchases are aid-funded, so they do not show the same decline as open-market purchases. South African diammonium phosphate imports were virtually non-existent in 2013, after rising to 65,000-85,000 t/yr in 2011 and 2012 because of lower domestic output. Senegal and Cote d'Ivoire imported 70,000t each in 2013 while no other African country imported more than 50,000t of ammonium phosphates.

Middle East

Diammonium phosphate dominates the limited ammonium phosphates trade in this region, with Iran the only significant importer. Iranian imports fluctuated in the 150,000-250,000 t/yr range in 2004-10 but fell to virtually nothing in 2012, as a result of sanctions. But imports increased again to 60,000t in 2013, with a revival in imports from Iraq which stood at 114,000t — a record high since 2000. Tunisia and Russia have traditionally been the main exporters to the region, but have now been displaced by Jordan and China.

South Asia

The Indian subcontinent is a major importer of ammonium phosphates, notably India and Pakistan, and both countries saw a significant increase in diammonium phosphate imports in recent years before they collapsed by 27pc year on year in 2013. The pattern of imports for 2013 is shown in the following table.

Table 1-47: South Asian Imports of Ammonium Phosphates, 2013 *'000t product*

	Exporter									
	Lithuania	Russia	USA	Morocco	Tunisia	Jordan	Saudi Arabia	China	Australia	Total
Total MAP & DAP	**43**	**-**	**702**	**44**	**-**	**131**	**1,091**	**2,700**	**252**	**4,964**
MAP	**-**	**-**	**-**	**7**	**-**	**-**	**-**	**69**	**-**	**76**
Bangladesh								9		9
India								57		57
Pakistan				7				3		10
Sri Lanka										-
DAP	**43**		**702**	**37**	**-**	**131**	**1,091**	**2,631**	**252**	**4,888**
Bangladesh							53	143	167	363
India			702			131	879	2,009		3,720
Nepal										
Pakistan	43			37			159	475	85	800
Sri Lanka								4		4

— IFA

The Indian subcontinent market attracts imports from a number of suppliers:

- Before 2013, the most remarkable feature of Indian trade policy was the substantial increase in imports of ammonium phosphates. Imports of diammonium phosphate in India rose to 7.8mn t in 2010 from 2.5mn t in 2007. A burgeoning subsidy bill, procedural issues with the payment of NBS subsidies, high inland inventories and a significant depreciation in the value of the rupee have since caused imports to fall to around 3.7mn t in

2013. According to the latest FAI data, diammonium phosphate imports rose by 11pc during the Indian fertilizer year (April to December 2014) on the back of a stronger domestic demand and lower international prices;

- The US has retained a position in India — one of its few remaining significant markets outside the Americas — although the US has lost market share to freight-logical Saudi Arabia and low-cost material from China;

- China has emerged as a significant exporter to India and Pakistan. While the monoammonium phosphate exports are a "lite" product (between 44-46pc P_2O_5), diammonium phosphate exports may also not meet international specifications, depending on the plant of origin;

- Lithuania shipped 43,000t of diammonium phosphate to Pakistan while Russia was absent from the Indian market in 2013, focusing on European markets and Latin America. Again, both countries have been squeezed out of the market by China and Saudi;

- Tunisia shipped 323,000t of diammonium phosphate to India, Pakistan and Bangladesh in 2010, but this trade collapsed in 2011 to only 25,000t and nothing in 2012 and 2013 as production and exports were hit by political turmoil;

- OCP traditionally did not ship to the region since it has a downstream processing unit in India and a joint venture in Pakistan to produce diammonium phosphate. However, 2009 saw its first exports of diammonium phosphate into India and Pakistan, totalling 315,000t, and these increased to 777,000t in 2012 before collapsing to 44,000t in 2013 on the back of lacklustre Indian demand.

- IPL in Australia shipped 252,000 t/yr of diammonium phosphate to the Indian subcontinent in 2013, with Bangladesh accounting for 66pc of the imports to the region.

Southeast and East Asia

The region is a significant market for ammonium phosphates, with 2.3mn t imported in 2013, as summarised in the following table.

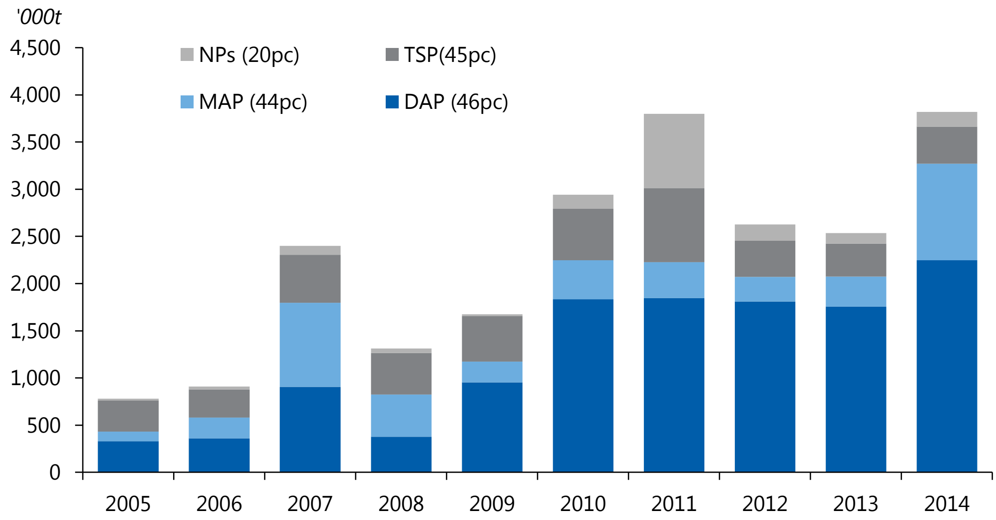
Table 1-48: Southeast and East Asian Imports of Ammonium Phosphates, 2013							*'000t product*
MAP	**US**	**Morocco**	**Russia**	**Saudi Arabia**	**China**	**Various**	**Total**
Total	**118**	**0**	**2**	**0**	**78**	**0**	**198**
Indonesia	0	0	0	0	4	0	4
Malaysia	0	0	0	0	17	0	17
Philippines	0	0	0	0	0	0	0
Thailand	8	0	0	0	21	0	29
Vietnam	0	0	1	0	8	0	9
China	7	0	1	0	0	0	8
Japan	103	0	0	0	9	0	112
South Korea	0	0	0	0	0	0	0
Taiwan	0	0	0	0	19	0	19
Others	0	0	0	0	0	0	0
DAP							
Total	**427**	**114**	**187**	**239**	**1,000**	**162**	**2,122**
Indonesia	0	0	9	16	127	0	152
Malaysia	0	0	13	0	37	7	57
Philippines	0	0	2	0	65	35	102
Thailand	82	30	124	159	100	16	511
Vietnam	0	0	39	0	487	52	577
China	139	79	2	54	0	0	272
Japan	206	5	0	10	171	4	396
South Korea	0	0	0	0	7	47	54
Taiwan	0	0	0	0	0	1	1
Other	0	0	0	0	6	0	0
Total AP	**545**	**114**	**189**	**239**	**1,078**	**162**	**2,320**
Indonesia	0	0	9	16	131	0	156
Malaysia	0	0	13	0	54	7	74
Philippines	0	0	2	0	65	35	102
Thailand	90	30	124	159	121	16	540
Vietnam	0	0	39	0	495	52	586
China	146	79	2	54	0	0	280
Japan	309	5	0	10	180	4	508
South Korea	0	0	0	0	7	47	54
Taiwan	0	0	0	0	19	1	20
Others	0	0	0	0	6	0	0
							— IFA

China now dominates the regional market and accounted for 46pc of ammonium phosphate exports to the region in 2013. The US has maintained a presence in its traditional markets (Thailand and Japan) with 23pc of exports to the region. Some US tonnage was also imported into northeast China in 2013, at a significant premium to domestically produced product. The tonnage delivered to Vietnam is now in decline following the start-up of the Vinachem Hai Phong diammonium phosphate unit in 2009, which has so far operated at low capacity and produces a 61 nutrient unit ammonium phosphate. Also, it is widely reported that Vietnam will not implement the 20pc VAT on Chinese ammonium phosphate imports announced in early 2015. Although we did not anticipate a huge impact as a result of this rise from 3pc to 20pc, it is almost a certainty now that Vietnam will continue to be a major diammonium phosphate outlet for China through 2015 (China exported over 600,000t of diammonium phosphate to Vietnam in the first eleven months of 2014).

Focus: Chinese ammonium phosphates exports

The chart below presents the evolution of Chinese monoammonium phosphate and diammonium phosphate exports since 2005, along with TSP and NPs. Total exports peaked at just under 4mn t in 2011, partly because of a lack of export duty when diammonium phosphate and monoammonium phosphates were subject to high peak season duties. This loophole was closed in 2012 which explains some of the decline, but it is also believed that the poor quality of the product arriving in India has curtailed demand significantly.

Figure 1-13: Chinese phosphates exports by product, 2005-14



— China Customs

In the case of ammonium phosphates, exports peaked at about 3.8mn t P_2O_5 in 2011 and again in 2014. Diammonium phosphate exports during 2010-11 totaled around 4mn t product while monoammonium phosphates exports totaled just under 1mn t. The most significant feature of the 2014 picture is the surge in monoammonium phosphates exports to Latin America, reaching 2.3mn t product in 2014 while diammonium phosphate exports have increased to around 4.9 mn t product.

The pattern of Chinese exports is directly linked to the export restrictions first introduced by the government in 2005, as the domestic phosphate industry started to grow. In 2007, export duties and limitations were introduced to encourage domestic product to remain in China to protect domestic supply and maintain stable pricing. In 2008, when international prices were particularly high and tempting for Chinese producers, the government introduced a punitive export tariff on diammonium phosphate during the peak domestic season. Since then the duty has been revised annually. But it was not until 2014 that we first saw real easing of the export tax window. Chinese producers were encouraged to export more product during the first quarter, enabling them to meet demand in countries where seasonality did not coincide with the low tax window. In 2014, Chinese DAP/MAP exports were subject to a Yn50/t tax rate during the low export tax window (mid-May to mid-October) and a Yn50/t + 15pc export tax applied during the high season, compared with 5pc in 2013 during the low export tax window and 80pc applied during the high season.

This change in policy resulted in a radical shift in China's export strategy. For example, monoammonium phosphate exports increased by 192pc to 1.65mn t between January and October, with Brazil importing 886,000t during this period, while Australia imported 170,000t of monoammonium phosphates in the first half of 2014. DAP exports increased by 28pc year on year, with growth in markets including Pakistan, Vietnam, Thailand, Philippines, Malaysia and New Zealand. But exports to India fell by 43pc year on year. The suspension of the 6pc duty on DAP with less than 6ppm arsenic in Brazil could also favour Chinese DAP in 2015, as well as from other origins. A number of Chinese producers are switching to producing international standard MAP (11-52) in a bid to gain entry to the Brazilian market. Wengfu started producing the product in 2013 and has recently started producing the 11-52 grade too

A recent government announcement on 2015 export policy has confirmed that a flat tariff of Yn100/t for DAP and MAP will be imposed and that the export window has been removed.

The key question is whether this new regime will result in increased Chinese DAP and MAP exports. While it is clear that there are significant benefits in exporting under the new tax regime during what would have been the old high tax window, we do not believe that this will lead to heavier exports during this period. Outlined below are the potential fob netbacks to integrated producers based on the 2014 and 2015 policies. The analysis is theoretical, and there are still rumours circulating of a reintroduction of a VAT on domestic sales and exports, to encourage supply side consolidation and force marginal producers out of the market.

There is some confusion as to what rate, if any, of VAT will be applied. Sources suggest an additional tax of 13pc on both raw materials and final product will be unlikely and could lead to demand destruction if producers pass on costs to the finished product.

Excluding the potential reintroduction of VAT, and allowing for current sulphur, ammonia, phosphate rock and conversion costs, the DAP ex-plant production cost for an integrated Chinese producer on a rock and ammonia basis was estimated at $346/t in January, while the cost for a non-integrated producer was estimated at $447/t. Adding inland transport, port handling costs and export tax, the theoretical cost to fob for integrated and non-integrated producers is estimated at $437/t and $517/t respectively. With reports indicating netbacks on a fob basis from the domestic market at close to $490/t, coupled with limited Indian demand, Chinese producers are currently incentivised to focus on the domestic market.
In other words, the new export policy is likely to result in a more uniform distribution of exports throughout the year as a result of:

- Chinese producers having more domestic and export options;
- Administration being easier — fewer charges of tax avoidance;

- A likely reduction in DAP or MAP exports in the first quarter unless domestic offtake is poor;
- Chinese producers continuing to diversify into new products and markets.

Oceania

Australia still imports ammonium phosphates. In 2013, the main suppliers were the US (314,000t), Mexico (238,000t) with the restart of the Fertinal production and China (80,000t). We also note that Foskor (South Africa) exported 112,000t of monoammonium phosphates to Australia in 2013. Total imports into the region amounted to around 800,000t of ammonium phosphate in 2013. Australia itself exports into Asia, with around 300,000-470,000 t/yr moving to this region in recent years. The trade to and from Australia is determined by logistics and seasonality.

Latest data released by GTIS show the increasing domination of the Australian DAP/MAP import market by Chinese producers. Australian DAP imports for the first quarter of 2015 stood at 145,000t, up by 105pc year on year. Of this total, China accounted for 92,000t, or 63pc. This has been at the expense of US imports, which have fallen by roughly half since 2013, and accounted for 36,000t, with Mexico third at 16,000t. The situation is similar for MAP, total January-March imports stand at 376,000t, up by 17pc year on year. Of this total, China is now the second largest supplier behind the US with 121,000t, a rise of 225pc. The US saw its MAP exports fall by nearly a quarter to 124,000t while Mexico exported 111,000t, up by 19pc. Two factors underlie the growth in Chinese phosphate exports to Australia:

- The relaxation of the Chinese export tax policy which took place this year, effectively permitting all-year round exportation of phosphate fertilizers;
- Chinese product has become more established in Australia.

Table 1-49: Oceania Ammonium Phosphates Imports, 2013 *'000t product*

MAP	US	Morocco	China	Mexico	Various	Total
Total	**217.1**	**0**	**6.5**	**182.9**	**111.5**	**518.1**
Australia	217.1	0	6.3	182.9	111.5	517.9
New Zealand	0	0	0.2	0	0	0.2
DAP						
Total	**96.7**	**9.3**	**73.7**	**54.8**	**44.1**	**278.9**
Australia	96.7	0	8.3	54.8	0	159.8
New Zealand	0	9.3	62.2	0	44.1	115.9
Other	0	0	3.3	0	0	3.3
Total AP	**313.9**	**9.3**	**80.2**	**237.7**	**155.7**	**797**
Australia	313.9	0	14.6	237.7	111.5	677.7
New Zealand	0	9.3	62.4	0	44.3	116.1
Other	0	0	3.3	0	0	3.3

— IFA

7.3. Outlook for Ammonium Phosphates

The differences between the superphosphate and ammonium phosphates sectors are stark. In the future there may be a couple of new triple superphosphate plants built in Brazil, or to supply Brazil, and as a replacement for the Sfax unit in Tunisia.

Closures will exceed the commissioning of new capacity. In respect of ammonium phosphates, the capacity listing shows a 7.1mn t/yr net increase in diammonium phosphate capacity and a 4.5mn t/yr net increase in monoammonium phosphate in 2014-20 *(see Appendix for full project listing)*. Over 2.5mn t/yr of this new capacity is assumed to come from China. A remarkable feature of the fertilizer sector in China has been the speed with which plants are constructed. There is generally a period of 1-2 years between project announcements and commissioning, and in some cases less than a year. The plants tend to be small in terms of world scale — 300,000-500,000 t/yr product and many are located at existing sites, which partly explains some of the very short construction schedules. But it is doubtful whether China will be able to operate its new capacity at high rates, and, given problems with low P_2O_5 and high magnesium in its rock, it will have continuing difficulties producing on-specification diammonium phosphate or monoammonium phosphate.

China aside, the focus of new capacity will primarily be the Jorf Phosphate Hub and the Ma'aden-Mosaic joint venture project, with only limited expansion activity elsewhere.

Table 1-50: World DAP Capacity by Region, 2014-22 *'000 t/yr*

	2014	2015	2016	2017	2018	2019	2020	2021	2022
World Total	**60,252**	**60,837**	**62,727**	**65,402**	**66,152**	**67,392**	**68,012**	**68,322**	**68,929**
West Europe	2,290	2,290	2,290	2,290	2,290	2,290	2,290	2,290	2,290
EECA*	2,231	2,231	2,066	2,231	2,231	2,231	2,231	2,231	2,231
Africa	6,380	7,310	8,550	8,860	8,860	10,100	10,720	11,030	11,637
North America	10,802	9,952	9,952	9,952	9,952	9,952	9,952	9,952	9,952
Latin America	1,122	1,122	1,122	1,122	1,122	1,122	1,122	1,122	1,122
Middle East	4,694	4,694	4,694	5,444	6,194	6,194	6,194	6,194	6,194
South Asia	8,461	8,461	8,711	8,961	8,961	8,961	8,961	8,961	8,961
Southeast Asia	495	660	825	825	825	825	825	825	825
East Asia	22,937	23,277	23,677	24,877	24,877	24,877	24,877	24,877	24,877
Oceania	840	840	840	840	840	840	840	840	840

**eastern Europe and central Asia*

— Argus consulting

Table 1-51: World MAP Capacity by Region, 2014-22 *'000 t/yr*

	2014	2015	2016	2017	2018	2019	2020	2021	2022
World Total	**28,393**	**28,873**	**29,513**	**30,653**	**31,153**	**31,793**	**32,503**	**32,978**	**33,291**
West Europe	60	60	60	60	60	60	60	60	60
EECA*	2,895	2,895	2,895	2,895	2,895	2,895	2,895	2,895	2,895
Africa	1,650	2,130	2,770	2,930	2,930	3,570	3,890	4,050	4,363
North America	4,790	4,790	4,790	4,790	4,790	4,790	4,790	4,790	4,790
Middle East	1,763	1,763	1,763	1,763	1,763	1,763	2,153	2,468	2,468
Latin America	0	0	0	500	1,000	1,000	1,000	1,000	1,000
East Asia	16,995	16,995	16,995	17,475	17,475	17,475	17,475	17,475	17,475
Oceania	240	240	240	240	240	240	240	240	240

** eastern Europe and central Asia*

— Argus consulting

There is little doubt that the supply-demand situation for phosphates as a whole and ammonium phosphates in particular is tightening. The apparent threat of serious overcapacity, as a flurry of projects emerged in the boom years of 2007 and 2008, was always more apparent than real. Generally speaking, only a small proportion of the many projects proposed during a boom reach fruition in the following years. The cutback in expansions has been sharp on this occasion for a number of reasons:

- The age of many of the main industries and consequent falling reserves is restricting expansion in traditional producing areas, such as South Africa, the US and Israel. In South Africa and the US there is more likely to be further contraction of supply;

- The cost of greenfield projects or even a new mine is high. Raising the finance for projects, especially vertically integrated projects, has become difficult under the current financial conditions, which are likely to prevail for some time;

- The willingness of governments to support projects has been reduced by changing politics, and by the financial squeeze that most countries are experiencing. The Chinese government has signalled its intention to halt the expansion of its processing capacity after the current raft of projects has been commissioned. The next priority will be rationalising existing capacity and boosting efficiencies in mining, beneficiation and the operational rates at processing units;

- The opportunity of expanding supply is falling on ever fewer participants, currently OCP and Ma'aden. JPMC is not expanding its production of diammonium phosphate, but will increase merchant acid output to serve offshore joint ventures. Their cost advantage over greenfield projects is such that any analysis of industry competitiveness is likely to make greenfield ventures look risky. The current financial climate will slow progress on new projects at best, but more often halt it;

- A number of projects are looking to reduce the need for upfront financing by phasing their development plans: first run-of-mine ore exports, then beneficiated concentrate exports and eventually processing. Generally, the quality of the rock prior to beneficiation (and often after) is not likely to attract prices in line with OCP and Jordanian acid-grade rock. With OCP able to export rock at about 20-30pc of the breakeven cost of most projects, even staged implementation looks risky, especially as the project is unlikely to produce rock of merchant quality. The risk is further heightened by a decrease in trade in merchant rock, and a preference for companies such as OCP and JPMC to incorporate rock sales into joint ventures or arrangements that guarantee a fair share of the processing gain. This is likely to tie in existing and new non-integrated NP/NPK capacity.

There are a few key points to make in relation to the outlook for ammonium phosphates, highlighting issues raised in previous sections:

- The only major growth in acidulated phosphate fertilizers is expected in the ammonium phosphates sector and NPKs based on ammonium phosphates;

- All new plants for chemically combined compound fertilizers will use the ammonium phosphates route. There are no projects for nitrophosphate plants. Yara is unwilling to license its process. In any event, by-product ammonium nitrate is no longer a welcome product in most countries, and calcium ammonium nitrate is not an established product in most developing markets;

- Many of the world's more developed regions are opting for blending, but also steam granulation and compaction as manufacturing routes for NPK fertilizers. Chemically combined NPKs are becoming niche products in these regions, often containing trace elements and secondary nutrients that may be difficult to introduce to a blend in the small proportions required. There is growth in small compaction/steam granulation units that can produce NPKs, sometimes operated alongside blending units, which can introduce trace elements to the compounds produced. Ammonium phosphates represent an important feed for these plants in the production of fertilizers for the food sector. The greatest growth potential for these plants in the short term is in Asia, as a result of the growing need for potash applications, and as a result of the structure of agriculture and land ownership. Demand may grow strongly in Africa in the medium term.

- The US market is dominated by blending, for which the first granular ammonium phosphates were developed. Mosaic and Simplot have also launched modified ammonium phosphate products containing sulphur and trace elements as blend components, which go some way to overcoming the problem of introducing secondary nutrients and trace elements to blended fertilizers. OCP is marketing an ammonium phosphate sulphate 19-38-0-7S, 12-46-0-7S and 12-48-0-5S. It is also now offering micronutrient-enriched compounds: 12-45-0-5S-1Zn and 14-23-14-5S-1 B_2O_3.

- In terms of trade, all P_2O_5 containing products apart from ammonium phosphates are at best static. Triple superphosphate fails to offer the economic advantages of ammonium phosphates and is used only where low-nitrogen fertilizer is required, where blenders use ammonium nitrate products as the nitrogen donor, or where domestically produced nitrogen is adequate to supply the market and imports of nitrogen are not encouraged.

In terms of specific capacity developments in the short term, the following can be said:

- Apart from China, the Ma'aden start-up and the OCP expansions are the only significant new capacity to enter the market in the last 3 years. Ma'aden is assumed to only have achieved full capacity in end-2014;

- Vinachem completed a long-delayed 330,000 t/yr diammonium phosphate unit at Hai Phong, Dinh Vu province in Vietnam in 2009. The Chinese contractors/technology suppliers have apparently had problems with both the beneficiation of rock and the process technology, and the unit has been operating at 30pc utilisation for a while. However, 2013 production levels indicate a higher operating rate of 67pc. Vinachem is constructing a second 330,000 t/yr unit in northern Lao Cai province (adjacent to China's Yunnan province) which is scheduled to come on stream in 2015;

- Vale completed an expansion of its Uberaba monoammonium phosphates capacity by an assumed 150,000 t/yr (or more depending on the production split with triple superphosphate) in 2012;

- There is some doubt regarding the progress of Pequiven's 250,000 t/yr diammonium phosphate unit at Moron, Venezuela. The unit was originally due on stream in 2010, but then delayed to 2014. If it was effectively put on stream in 2014, the plant must have been running at low utilisation rates because of gas supply issues affecting the ammonia facility;

- A number of permanent closures have occurred in recent years, mainly of non-integrated capacity faced with regulatory restrictions relating to phosphogypsum disposal, or rising costs. In the US, there was the closure of the Agrifos Pasadena unit in early 2011, and the recent closure of the Mississippi Phosphates Pascagoula plant after filing for Chapter 11 bankruptcy in October 2014. Police's 490,000 t/yr diammonium phosphate unit in Poland is also expected to face problems in the medium term. The production of acid may be extended by a recent switch to the production of a larger proportion of NPKs, which reduced both the acid requirement and the gypsum output. It can be assumed that production of monoammonium phosphates will be maintained into the medium term at Agrium's Redwater plant in Canada, despite the exhaustion of the Kaspuscasing mine in 2011, thanks to the recent rock supply agreement signed with OCP;

- Chinese export availability will continue to fluctuate in response to seasonal shifts in government export tax policy. As mentioned earlier in this report, the new export policy for 2015 is likely to result in a more uniform distribution of exports throughout the year, rather than a surge in exports. Ultimately, as the domestic industry is reshaped, old, small-scale producers will close, and production will move to locations where phosphate rock is mined. Simultaneously, the fragmented and inefficient rock mining industry is being rationalised. China is not expected to maintain its position as one of the leading net exporters of phosphates in the long term.

In the longer term, the following is assumed:

- The Jorf Phosphate Hub will be implemented according to plan. Four integrated ammonium phosphate plants (with a 940,000 t/yr capacity each) are due for completion within 2016, adding almost 4mn t/yr of ammonium phosphate to export availability, along with the recent commissioning of two new granulation units totaling 1.7mn t/yr, as part of OCP's optimisation strategy at the existing complex. In our base case, we assume that the four new units will split production between diammonium phosphate (two thirds) and monoammonium phosphates (one third);

- A number of firms expressed interest in participating in the Jorf Phosphate Hub back in 2010, although OCP appears to be progressing the current tranche of project without third party involvement;

- The Ma'aden-Mosaic joint venture project is assumed to start up in 2017-18. A fertilizer capacity of 3mn t/yr is included as part of the project, which in our base case we assume to be 1.5mn t/yr of diammonium phosphate, 1mn t/yr of monoammonium phosphates and 500,000 t/yr of NP/NPKs. However, the participation of Mosaic is likely to see a range of more sophisticated multi-nutrient products offered to the market;

- As OCP capacity is ramped up and the new Ma'aden-Mosaic joint venture comes on stream, further permanent capacity closures are expected in the US, or at least a gradual switch from diammonium phosphate to monoammonium phosphate and products such as MicroEssentials. Mississippi Phosphates has already announced the closure of its Pascagoula plant, removing some 600,000 t/yr of diammonium phosphate production from the US market. Elsewhere, non-integrated capacity without the degree of protection and support for developing offshore joint ventures enjoyed by the Indian industry is vulnerable. Even in India, rock-based production will be under threat, although Phosphogypsum does not create the same problems in India as elsewhere, as it is used in building materials;

- The corollary of this argument is that only countries with vertically integrated industries will be in a position to invest in new export capacity. In the case of many countries, increasing processing capacity will directly result in a reduction in merchant phosphate rock availability. Any significant investment in a non-basic plant is most likely to take the form of a joint venture with a rock supplier seeking to diversify its geographical production base;

- The Ferfos 1.05mn t/yr diammonium phosphate project at Jijel, Algeria is currently removed from the listing as no progress has been reported;

- The planned monoammonium phosphates/TSP Anglo American (Copebras) expansion at Catalao has been put back by several years to 2020-21, delayed by the aborted sale of Anglo-American's share in the company. As previously mentioned, Galvani's proposed new MAP/TSP/SSP capacity totalling 400,000 t/yr P_2O_5 and associated with the Serra do Salitre mine development is delayed and expected on stream in 2020-21. Permits have yet to be granted for the company's Santa Quiteria project;

- A long-proposed downstream project in Peru based on the expansion of the existing Bayovar mine now seems unlikely. Problems over gas availability and pricing are undermining the development of ammonia capacity and the shareholders may prefer the continuance of rock exports;

- It is assumed that GCT in Tunisia will only develop new triple superphosphate capacity, but the timing of such a project is uncertain unless there is a significant improvement in the political climate and the current tortuous planning process. A number of new joint-venture projects have been floated by junior mining companies that could produce more ammonium phosphates, but they are still at an early stage. Any reduction in shipments of phosphoric acid would speed a triple superphosphate or ammonium phosphates project at a GCT site. Such expansions have been under consideration for many years;

- New capacity aimed at supplying phosphoric acid to the Indian market (JIFCO joint venture with IFFCO) and phosphate rock to Indonesia (PT Petro Jordan Abadi joint venture with PT Petrokimia Gresik) came on stream in 2014. In September 2014, JPMC signed an initial agreement with China's Chongqing Minmetal and Machinery Import and Export over plans to build a new fertilizer plant in Aqaba expected to consume 1.5mn-2mn t/yr of phosphate rock. According to the company, this project "is part of the company's strategy to optimally utilise raw phosphate and turn it into high value-added products instead of exporting it as raw materials". JPMC signed another initial agreement with GNFC in early 2015 to build a phosphoric acid plant in India that would utilise 1mn t/yr of Jordanian phosphate rock. None of these projects have been included in our capacity listing as both are at an early stage of development;

- The development of new ammonium phosphates capacity in Australia at IPL's existing Phosphate Hill complex is excluded, given the rising costs of sulphur and ammonia onsite. Developments based on new mines currently under investigation appear to have lost momentum.

The focus of most new investment in ammonium phosphates, or modified ammonium phosphates capacity, is not expected to change dramatically in 2020-29 — major new export capacity will be located in Saudi Arabia and Morocco. Potential investment in greenfield export capacity elsewhere will be kept in check by developments in these countries, and there is little reason to assume that either an Australian project or the development of capacity based on offshore rock (Namibia or New Zealand) will proceed in the period to 2029.

In the case of Morocco, the six remaining plants under the JPH programme — including the two OCP-Gabon joint-venture units taken in the base case to start in 2019 — are assumed to come on stream at Jorf in 2019-25 with 6mn t/yr of ammonium phosphate capacity. Clearly, if there is a tightening in the supply-demand balance in 2015-20, then OCP is in pole position to utilise its Jorf infrastructure to rapidly expand capacity. It is noted that these ammonium phosphates units could also be located under a joint venture in other countries supplied by the new Jorf acid units.

On the other hand, OCP is investing in the development of the new Safi complex under the Safi Phosphate Hub programme (SPH), through the addition of further integrated fertilizer production units and required infrastructure, including port expansion. The SPH platform will include a total phosphoric acid capacity of 2.8mn t/yr P2O5, along with associated granulation capacity for the production of DAP/MAP/NPKs/TSP/Feed Phosphates, and is planned come on stream in 2021-22. The addition of downstream capacities at Boucraa and the development of the Laayoune port are also currently under study.

7.4. Main Conclusions

The main points arising from the analysis can be summarised as follows:

- Ammonium phosphates and multinutrient fertilizers based on phosphoric acid, whether blended or co-granulated, will be the most significant growth products in the acidulated phosphate fertilizer sector;
- Ammonium phosphates and modified ammonium phosphates will continue to dominate world trade, as traded volumes of all other phosphate products — superphosphates, merchant acid and chemically combined NPKs — are either static or in decline;
- The major swing factors in the global ammonium phosphate trade will remain India's import appetite and China's export volumes;
- Ammonium phosphate plants based on imported rock will be vulnerable to closure as the economics of vertically integrated complexes are much stronger, unless a joint-venture agreement with a major rock supplier is agreed. This applies worldwide, but particularly to China's non-vertically integrated capacity;
- The majority of new capacity outside China will be located at existing production sites, in the form of either revamps or new units;
- OCP has expanded granulation capacity over the past few years to increase production and marketing flexibility. This is, in part, a response to the potential impact of exports from the first Ma'aden complex, which has affected purchasing strategy in India. But the slow build-up in Ma'aden production — and apparent failure to operate at its full utilisation rate — has smoothed out the market impact of the incremental export tonnage;
- The market share of monoammonium phosphates and modified products based on monoammonium phosphates is expected to grow relative to diammonium phosphate, as rock quality declines worldwide and the market adjusts to the growing need for secondary and micronutrients.

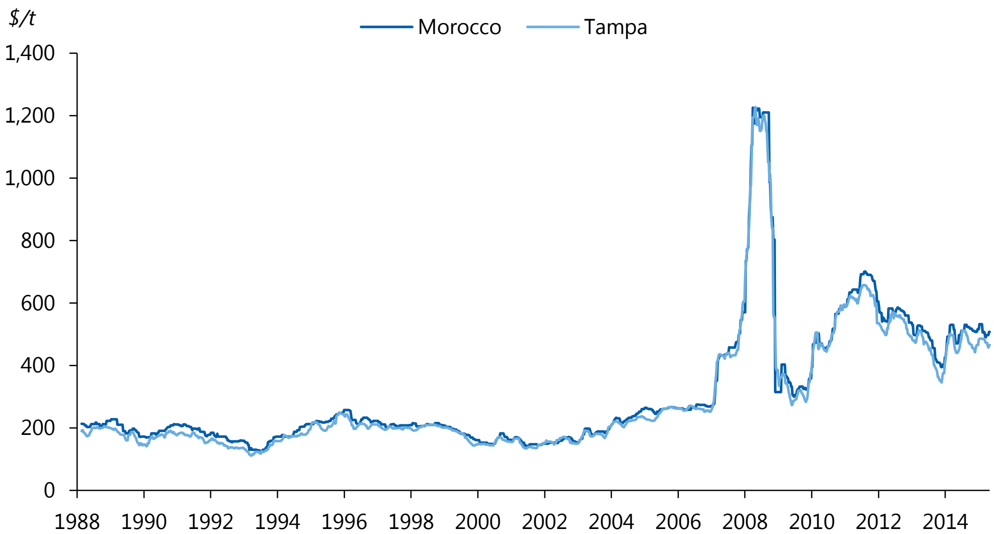
Section 2: Outlook for Processed Phosphates Prices

Chapter 1: Diammonium Phosphate Prices

OCP's degree of control over the international phosphates market is providing an ever-closer link between diammonium phosphate prices, other standard processed phosphate fertilizer prices and raw material products. Diammonium phosphate can be taken as the benchmark and an analysis and forecast of prices for this product follows.

1.1. Current situation

Figure 2-1: DAP fob prices



— Argus FMB

After a dramatic fall to $285-287/t fob Tampa and $290-310/t fob Morocco in 2009, from the exceptional market peak in the second and third quarters of 2008 of $1,100-1,200/t, diammonium phosphate prices have followed another significant cycle compared with the relatively flat historical cycles of pre-2007. A largely continuous sustained upswing in prices occurred from early-2010 to the third quarter of 2011 with Tampa fob prices peaking at $655-660/t in August 2011, while Morocco fob prices reached $680-710/t fob Morocco.

With phosphate demand weak in India in 2012-13 and 2013-14, coupled with the declining value of the rupee relative to the US dollar and demand intermittently weak in other major consuming markets, such as the US and Latin America, prices followed a largely downward trajectory with the Tampa reference falling to $380-410/t by mid-November 2013 and Morocco to $380-410/t. This represented the market "low" and prices subsequently staged a strong recovery pulled up by surging demand for monoammonium phosphates from Brazil and significant weather-related disruption in the first quarter of 2014 at Jorf which kept supply tight. Later in the year, DAP prices came under pressure again mainly because of limited activity in Brazil, amid ample inland stocks that allowed buyers to adopt a wait-and-see approach. Although buyer interest started to emerge at the beginning of 2015. the two key import markets, Brazil and India, have slowed in the second quarter of this year. At the time of writing, Tampa fob prices stand at around $470-480/t and Morocco fob prices at $500-510/t.

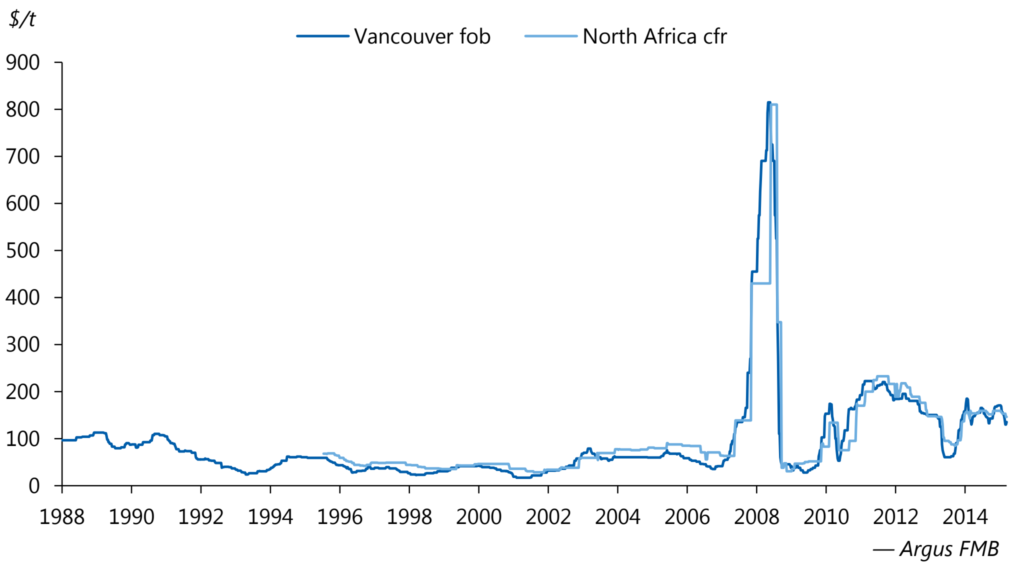
Developments in the key raw materials prices for the main integrated producers/exporters, with the exception of Ma'aden, are summarised as follows:

- Sulphur spot prices rose from a low of $25-30/t ex-Vancouver in June 2009 — following the spectacular 2008 boom-bust — to $210-225/t fob Vancouver in the second and third quarters of 2011. The subsequent period to May 2013 saw a slow decline in prices to around $150/t, but the market then saw a more significant drop to $50-70/t fob Vancouver in August 2013 (and lower to $25-50/t in the case of Black Sea product). Spot north African cfr prices likewise fell from $223-245/t in the third and fourth quarters of 2011, to $65-75/t in September 2013. The sharp decline in sulphur prices was largely caused by depressed demand for phosphates, with OCP and the US industry cutting back on production in response. As usual, producers that cannot pour to block (notably the Middle East and Kazakhstan) were forced to maintain exports as prices fell;

  Since November 2013, sulphur prices have shown renewed strength rising to $85-95/t fob Vancouver by end-November, with support from speculative trading activity in China and production problems in the Middle East, where delays to major new gas-processing capacity in the UAE have also played a part in shifting market sentiment. By mid-March 2014, sulphur prices had risen to $180-190/t fob Vancouver, while north African contract prices had adjusted to $125-140/t. Since then, fob Vancouver has been fluctuating between $130-185/t, while north African contract prices ranged from $140-160/t.

  In the medium to long-term we forecast a substantial oversupply in the sulphur market, starting in 2015 with a peak in 2017 before plateauing. Strong phosphate demand is unlikely to result in higher sulphur prices, given the amount of surplus product;

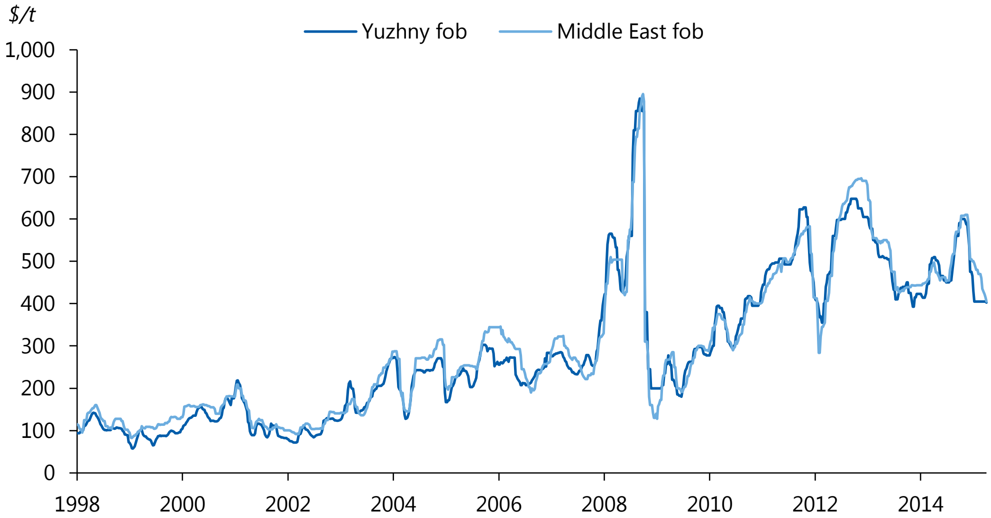
Figure 2-2: Sulphur Prices, cfr North Africa (contract) versus fob Vancouver (spot)



- Ammonia prices (fob Yuzhny and Middle East) have generally swung within a wide range of $400-600/t since the 2010 rebound in the merchant ammonia market, following the global financial crisis. Excluding the 2007-08 commodity boom-bust, this degree of volatility is unprecedented and reflects market tightness. The high price of oil and its direct and indirect link to ammonia prices in Ukraine and elsewhere, combined with various planned or unplanned curtailments to ammonia production/exports, such as Libya, Trinidad, Indonesia and Algeria (including the new 726,000 t/yr Sorfert ammonia unit which was commissioned in early 2014) drove prices higher throughout 2012. Supporting prices further during 2014 and into 2015 has been the Russian-Ukrainian crisis which has seen around 700,000 t/yr of ammonia export availability removed from the market with the cessation of production of two plants in east Ukraine (Gorlovka and Severodonetsk) plus additional merchant ammonia capacity lost with gas supply disruptions to other units in Ukraine during the course of the year. In October-November 2014, ammonia prices had risen to $590-610/t ex-Yuzhny and $580-640/t ex-Middle East. This compares with the most recent market low in mid-2013, when Yuzhny prices fell to $395-425/t and Middle East prices to $417-435/t — a period when diammonium phosphate production based on imported ammonia was cut-back in Morocco and the US, adding to an already sluggish market for ammonia imports for technical use in east Asia.

  During December 2014, ammonia prices started to decline and this process accelerated in January 2015. Poor weather for the US fall season applications of ammonia had already hit demand, in addition to ammonia prices being high relative to urea in the second half of 2014. And those players that could swing some capacity towards ammonia exports have tended to do so, adding to market availability. However, it is the decline in oil prices which has started to feed through to gas feedstock prices for those based on lagged formulas in eastern Europe, that is pushing the overall short-term floor in the market lower, and this is reflected in the more significant price decline. By mid-May 2015, Yuzhny ammonia prices had reached $400/t and Middle East $400-410/t.

Figure 2-3: Yuzhny and Middle East Ammonia Prices



— Argus FMB

1.2. Market Fundamentals and Price Outlook

1.2.1. Crop Price Outlook

Grain prices followed a steady downward trend in real terms between 1975 and 2005, as did fertilizer prices — despite a growing world population. Scientific developments (notably the Green Revolution) and the spread of irrigation saw significantly improved crop yields, which accommodated the growing population, albeit at low levels of nutrition for many. Since then there has been a structural break in agricultural commodity pricing, and a return to a long-term decline in crop prices is unlikely. These assumptions rest on the fact that the fundamental drivers of population and income growth will continue to support agricultural demand (to produce 1kg of beef protein requires 6-7kg of protein from feed grains). At the same time, growing urbanisation and inadequate water supply represent significant constraints to expansion in agricultural production, and, where possible land will have to be cultivated more intensively. Politically-driven demand for biofuels will also continue, even if the economic viability of these products is doubtful. Added to this is the move up the political agenda around the world of a desire for food security. A renewed focus on agriculture is evident for countries with large populations and/or exporters of agricultural commodities.

In the medium term, lower crop prices are anticipated with a rebound in US and global crop production. Stronger crop demand will support prices into the longer term with prices remaining above the levels seen prior to the pre-2007/08 boom. We present the USDA long-range crop price forecast for corn, wheat and soybeans in the table below.

Table 2-1: US Crop Prices to 2024/25			***$ per bushel***
		USDA Projections	
	Corn	**Wheat**	**Soybeans**
2010/11	5.18	5.70	11.30
2011/12	6.22	7.24	12.50
2012/13	6.89	7.77	14.40
2013/14	4.46	6.87	13.00
2014/15	3.50	5.90	10.00
2015/16	3.40	5.00	8.50
2016/17	3.50	4.65	8.55
2017/18	3.50	4.75	8.80
2018/19	3.50	4.80	9.10
2019/20	3.55	4.80	9.20
2020/21	3.55	4.80	9.30
2021/22	3.60	4.80	9.35
2022/23	3.65	4.85	9.40
2023/24	3.70	4.85	9.45
2024/25	3.75	4.85	9.55

— USDA Agricultural Projections to 2024, February 2015;

The key underpinnings of this forecast are as follows:

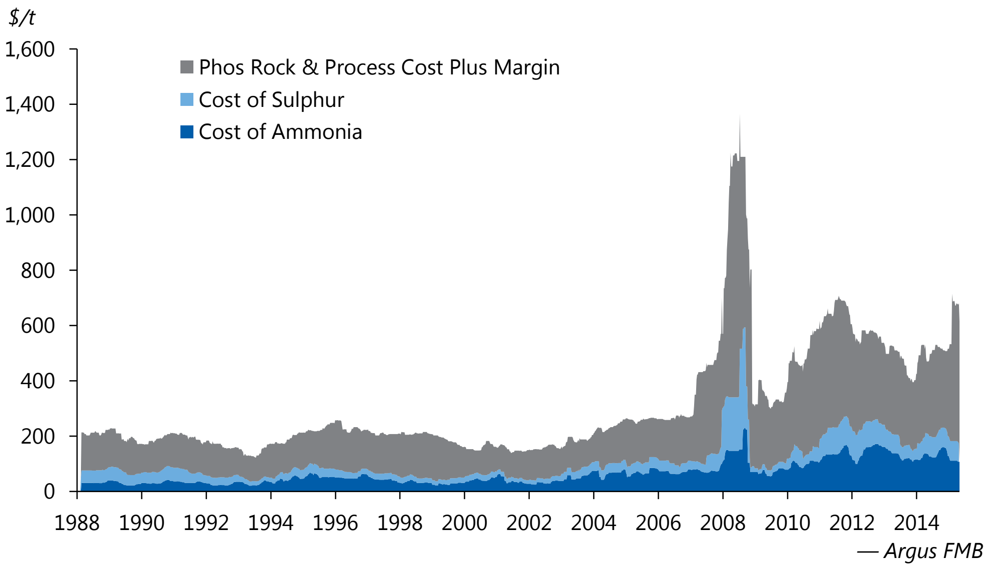
- Increasing yields will provide most of the gains in US production. This implies more fertilizer usage and/or more efficient fertilizer usage.
- Ethanol production will remain flat given the 10% ethanol 'blend wall', the projected declines in gasoline consumption and the infrastructural constraints limiting growth in the E15 whilst E85 grows but from a very small base. Ethanol exports are expected to show only limited growth. However, rising corn production will support rising feed and residual corn use. US corn exports are assumed to rise with strong global demand for feed grains also to support growing meat production.
- The decline in wheat plantings continues a long-term trend with relatively weak overall demand growth, with a mature domestic market and strong competition for exports from Russia and other countries of the Former USSR.
- Soybean plantings decline from the shorter-term high with lower prices and producer returns given strong competition from South America. Nevertheless, compared to historical levels, soybean acreage will remain relatively high with strong demand from China for feed-use as well as a projected rise in the US for soybean oil for biodiesel production.

1.2.2. OCP and Market Control

There can be no doubt that since 2007 Morocco's OCP has increased its influence over the international phosphates market and this is unlikely to change in the foreseeable future, although the company's view of where prices should comfortably be has in all likelihood shifted. Increasing control has coincided with a significant shift in the outlook for crop prices.

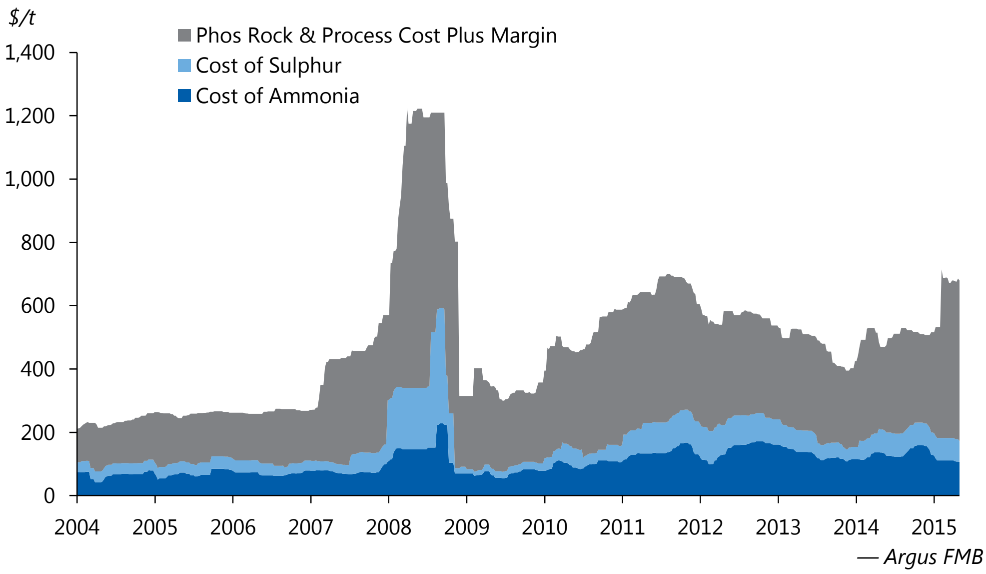
The chart below presents a disaggregation of the impact of ammonia and sulphur pricing on diammonium phosphate prices by taking FMB's long-run pricing benchmarks since February 1988 for diammonium phosphate fob Morocco, cfr north African sulphur (contract, except November 2008-February 2009), and cfr north Africa ammonia. Indication prices have been estimated for October 2008 to February 2009 when there was no reported market price.

Figure 2-4: DAP Costs and Pricing (Morocco)



Notes: Diammonium phosphate fob Morocco (basis US Gulf equivalent Oct 2008-Feb 2009); ammonia cfr north Africa (basis fob north Africa equivalent Dec 2008-Jan 2009); sulphur cfr north Africa contract (pre-September 1995 fob Saudi Arabia/UAE/Kuwait; November 2008 to February 2009 cfr north Africa spot)

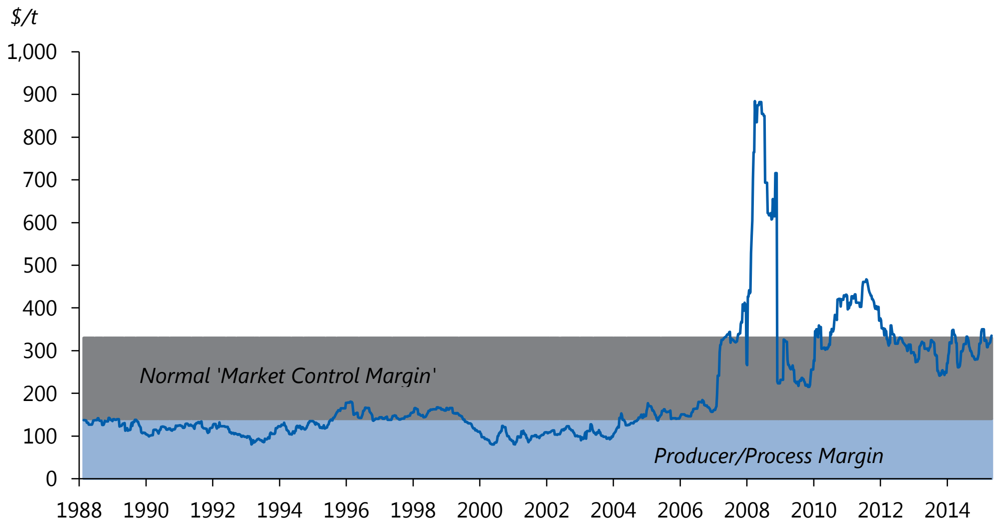
Figure 2-5: DAP Costs and Pricing (Morocco) — 2004 Onwards



Notes: Diammonium phosphate fob Morocco (basis US Gulf equivalent Oct 2008-Feb 2009); ammonia cfr north Africa (basis fob north Africa equivalent Dec 2008-Jan 2009); sulphur cfr north Africa contract (pre-September 1995 fob Saudi Arabia/UAE/Kuwait; November 2008 to February 2009 cfr north Africa spot)

After removing ammonia and sulphur costs from the price of diammonium phosphate ex-Morocco, a residual value is obtained that essentially covers the cost of phosphate rock, process costs and a producer margin. Prior to 2007, this cost/margin residual was remarkably stable — fluctuating in the $90-180/t range depending on the general fertilizer market cycle and with a long-run trend average of $130/t.

Figure 2-6: DAP - Phosphate Rock and Process Costs plus Margin



— Argus FMB

It can be argued, that there has not been a long-term shift in the cost of phosphate rock supply or process costs for existing producers, while recognising that the cost of developing new projects has risen significantly. What has changed is that the jump in the cost/margin residual in 2007 can be viewed as an indication of the extent of the new long-term "market control margin" that has arisen as a result of the strong position of OCP. While it is necessarily speculative, the view can be taken that this future control margin will be maintained at an average of $180/t, and this margin will fluctuate with general market conditions in the course of the normal cycle. A distinction can be made with abnormal market developments or margins — such as the commodity market spike of 2008 and the 2010-11 run-up across commodity sectors. The weakness in the phosphate market in 2013 and 2014 has seen the market control margin lower, at $135-148/t. As major new capacity comes on stream, the market control margin will likewise temporarily weaken until the new tonnage is absorbed into the market.

The base view in this report of the long-term shift in diammonium phosphate production costs and pricing is as follows:

- A new long-term contract cfr north African sulphur price of $100/t is assumed. This is some $45/t above the forecast made before the 2008 price spike, and represents a huge revision from where the market seemed to indicate pricing fundamentals in mid-2008, and a downward revision from where prices currently are on a spot basis. The shift relative to the previous long-term view represents a $20/t upward structural adjustment in terms of sulphur costs for diammonium phosphate production;

- In our view, a long-term downward adjustment in ammonia pricing occurred at the end of 2014, the second structural shift in the last ten years driven by energy pricing developments. The *Argus* Energy Consulting forecast is now for longer-term Brent pegged at $80/bl in constant dollar terms. As such, this represents a downward structural shift in long-term pricing of around $15 /bl which we translate into a long-term downward shift in ammonia prices of around $45-50/t.

The following table provides a forecast of fob Morocco diammonium phosphate prices, under "normal" market conditions, along with assumptions for ammonia, sulphur, the cost/normal margin residual (which is assumed to grow by 1.5-2pc/yr) and the market control margin.

Table 2-2: DAP fob Morocco Price Forecast to 2029 *$/t*

	DAP fob Morocco	Ammonia cfr north Africa	Sulphur cfr north Africa (contract)	Ammonia and Sulphur costs	Estimated/Forecast other costs plus normal margin	Market control margin
2004 actual	233	263	76	100	130	
2005 actual	260	277	83	107	132	
2006 actual	266	279	77	104	135	
2007 actual	431	302	101	121	137	
2008 actual/est*	984	587	441	345	139	499
2009 actual/est*	343	275	45	89	142	112
2010 actual	503	398	92	141	144	218
2011 actual	656	556	205	231	147	278
2012 actual	567	582	207	239	149	179
2013 actual	475	523	128	188	152	135
2014 actual	504	536	150	201	155	148
2015	500	488	165	196	157	146
2016	472	455	130	172	160	140
2017	461	415	110	153	163	145
2018	452	445	100	156	166	130
2019	485	465	100	161	169	155
2020	506	497	100	169	172	165
2021	526	508	100	172	175	180
2022	532	519	100	175	178	180
2023	538	530	100	177	181	180
2024	544	541	100	180	184	180
2025	550	552	100	183	187	180
2026	556	563	100	186	190	180
2027	562	574	100	188	194	180
2028	568	585	100	191	197	180
2029	574	596	100	194	201	180

**estimated prices are used for the period 4Q08 to Feb2009 where no market prices were reported.*

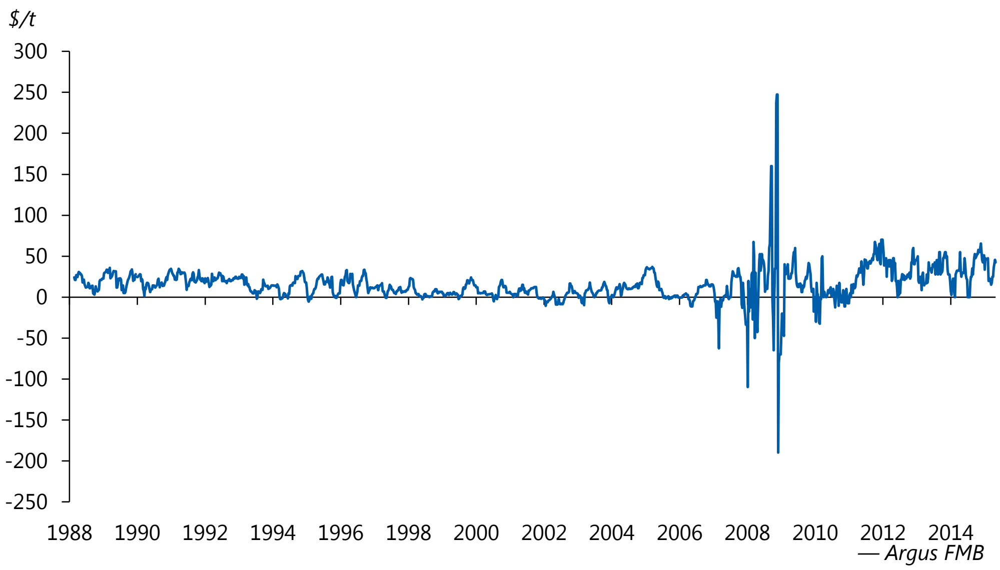
— Argus Consulting

According to the base model, the average price for diammonium phosphate of $567/t fob Morocco in 2012 reflects an implied market control margin at around the long-term trend of $180/t. This is well below the estimated average of $278/t in 2011, given the overall strength in the phosphates market for most of that year. In contrast, the weakness in the market in 2013 and 2014 is reflected in a lower market control margin at $135-148/t. In 2015, we expect the global trade to be supported by the emergence of Indian import demand in the second quarter on the back of low inland stocks. But heightened competition in the US and Brazilian import markets will emerge, especially from China and Saudi Arabia, assisted by the completion of at least one the four units under the Jorf Phosphate Hub program in Morocco. As such, prices are expected to average just above $500/t in 2015 for the fob Morocco price reference. For the period to 2019, we expect to see average annual prices sub-$500t/t with a market control margin mostly in the $130-155/t range.

The market control margin is assumed to come under more significant pressure in 2016-18, by which time OCP will have completed the first major tranche of capacity under the Jorf Phosphate Hub programme (JPH), adding around 4mn t/yr of ammonium phosphates to the current capacity. Additional pressure will come in 2017-18 with the start-up of the Ma'aden/Mosaic/Sabic joint venture phosphates export project. As the new capacity is commissioned it is assumed that the margin will fall to $130/t. However, even in periods of market weakness, average annual fob diammonium phosphate prices are not expected to fall below $460/t for more than a couple of months with an absolute floor of around $450/t, and are expected to mostly stay in the $460-500/t range on an annualised basis in 2015-19. Many Chinese exporters are estimated to have current costs to cfr India of around $450-480/t, including the export tax, and will halt exports if there is a significant reduction in prices. In any event, the withdrawal of Chinese tonnage from the export market as new capacity comes on stream elsewhere is expected, and will be a major factor providing support to the international market over the long-term. The long-term trend forecast is for Moroccan diammonium phosphate prices to rise to around $574/t fob by 2029.

The graph below presents the historical pricing differential for Moroccan product versus US Gulf product.

Figure 2-7: Morocco versus US Gulf DAP fob



- During the 20 years to 2008, the average premium of Moroccan product over US Gulf fob fell to $5/t from around $20/t as US product increasingly competed with Moroccan product in the Americas markets rather than east of Suez. The north African duty advantage over US and Russian phosphates in western European markets — although still important — became less of an issue in preserving the North African fob premium as total western European import volumes declined;

- In 2008-09, the differential widened again, but reflected a market in flux in the wake of the financial and economic crisis rather than shifting fundamentals. By 2010, with both Moroccan and US diammonium phosphate production operating at full capacity and the start of Moroccan diammonium phosphate imports into the US, the Moroccan premium narrowed to $4/t;

- The Moroccan premium over US product has widened again since 2011, with the political upheavals in north Africa and the Middle East, which saw Tunisian exports first halted and then only recovering to about 50pc of pre-2011 levels. This has allowed OCP to command higher prices in the western European import market, a market which was further boosted in the third quarter of 2013 by the closure of Fertiberia's diammonium phosphate unit at Huelva in Spain. In addition, the US domestic market has been relatively weak in 2012 and 2013, with plentiful availability of tonnage within the US, relatively low exports and large inventories. As a consequence, during the second half of 2013, the differential between Moroccan and Tampa prices widened to $45-55/t. Over 2014, the same differential has again widened to reach $60/t in in the fourth quarter;

- Over the longer term, Tunisia is presumed to return to normal export activity and the US is expected to gradually withdraw from the diammonium phosphate export market in favour of monoammonium phosphates and modified ammonium phosphate products (such as MicroEssentials), and also take more Moroccan imports. As such, the long-term discount for Tampa prices relative to Moroccan prices is expected to gradually narrow to $0-5/t.

With 2.9mn t of diammonium phosphate export capacity, the Ma'aden facility in Saudi Arabia is emerging as an important pricing benchmark and *Argus* FMB started a weekly price report for Saudi product in October 2011. It is assumed that the long-term differential between the Saudi Arabian and Moroccan price will be influenced by the following factors:

- Freight rates from Saudi Arabia to the key Indian market are likely to be around $25/t, some $15/t lower than for Moroccan tonnage, with a similar advantage to southeast Asia;
- As US diammonium phosphate exports decline, more Moroccan tonnage will be drawn into Latin America and at the same time OCP will continue to expand its presence in the US. These markets will clearly offer a freight advantage for Morocco relative to Saudi tonnage. The same will be true of exports into the premium western European market, with Saudi product facing duties in this market that are not applicable to Moroccan material;
- OCP's Jorf Phosphate Hub investment programme will see the construction of up to 10 phosphoric acid units at the Moroccan complex during the next decade. The company has the flexibility to choose the proportion of additional phosphates it moves into Asia and elsewhere in the form of phosphoric acid (for downstream processing into DAP/NP/NPKs within the final market) relative to the export of final product. It is assumed that OCP will choose the strategy that will best protect its overall netbacks;
- The average premium for fob Morocco over fob Saudi has grown from around $10/t on average in 2012 to $18/t in 2013, before rising to $40-45/t in 2014 as Ma'aden accepted lower netbacks in the Indian market and adopted a volume rather than a price strategy.

On balance, it is assumed that Saudi exporters will ultimately become more disciplined in their price strategy, especially with Mosaic's involvement in the upcoming joint venture, and as they diversify away from India with more volumes sold to Brazil (already started in 2014) and potentially Australia, especially if and when IPL closes down. As such, we assume that this price discount will gradually erode back to $10/t in 2015-18 and that the long-term Saudi diammonium phosphate fob price will revert to $0-10/t below that achieved by OCP.

The table below summarises the projections for the Moroccan, Tampa and Saudi Arabia fob diammonium phosphate benchmark prices.

Table 2-3: Tampa and Saudi Arabia DAP fob Price Forecast to 2029 $/t

	fob Morocco	fob US Gulf coast	fob Saudi Arabia
2004 actual	233	221	
2005 actual	260	249	
2006 actual	266	260	
2007 actual	431	427	
2008 actual*	984	966	
2009 actual*	343	320	
2010 actual	503	499	
2011 actual	656	621	
2012 actual	567	534	557
2013 actual	475	442	457
2014 actual	504	472	461
2015	500	480	470
2016	472	457	452
2017	461	451	446
2018	452	447	442
2019	485	483	477
2020	506	504	498
2021	526	524	519
2022	532	530	525
2023	538	536	531
2024	544	542	539
2025	550	548	545
2026	556	554	551
2027	562	560	557
2028	568	566	563
2029	574	572	569

**estimated prices are used for the period 4Q 2008 to Feb 2009 where no market prices were reported.*

— Argus Consulting

Chapter 2: Monoammonium Phosphate Prices

Argus FMB has reported a price for monoammonium phosphate (fob Baltic) since September 1999 and only since October 2011 has a reference for fob Morocco and cfr Brazil been included. As such, the Baltic fob benchmark is used to examine the key trends in monoammonium phosphates pricing.

As the graphs below show, Baltic monoammonium phosphate prices have followed Baltic diammonium phosphate prices closely, with no long-term trend difference. The additional nitrogen contained in diammonium phosphate (18pc versus 11pc) and differential freight rates to the key markets, have generally offset the additional phosphate content of monoammonium phosphate (52pc versus 46pc P_2O_5). In turn, the average historical netback differential between Moroccan and Baltic diammonium phosphate is $15-20/t.

Figure 2-8: Baltic DAP versus MAP Prices

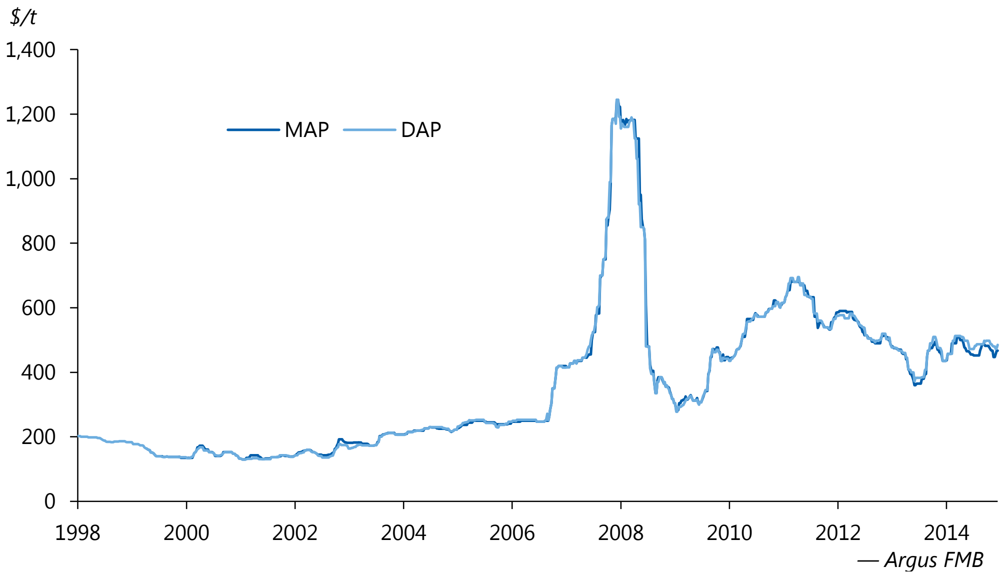
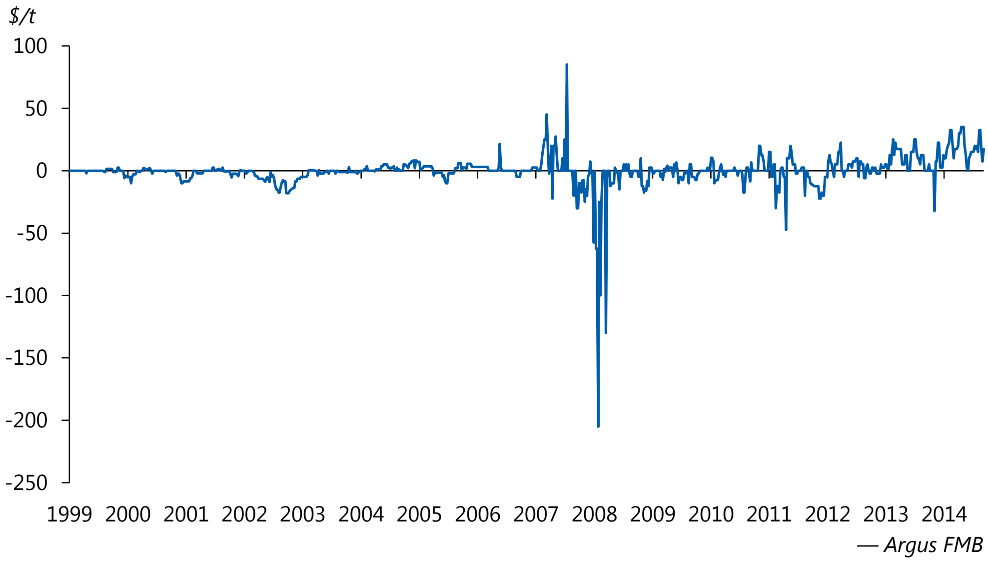


Figure 2-9: Baltic DAP-MAP Differential

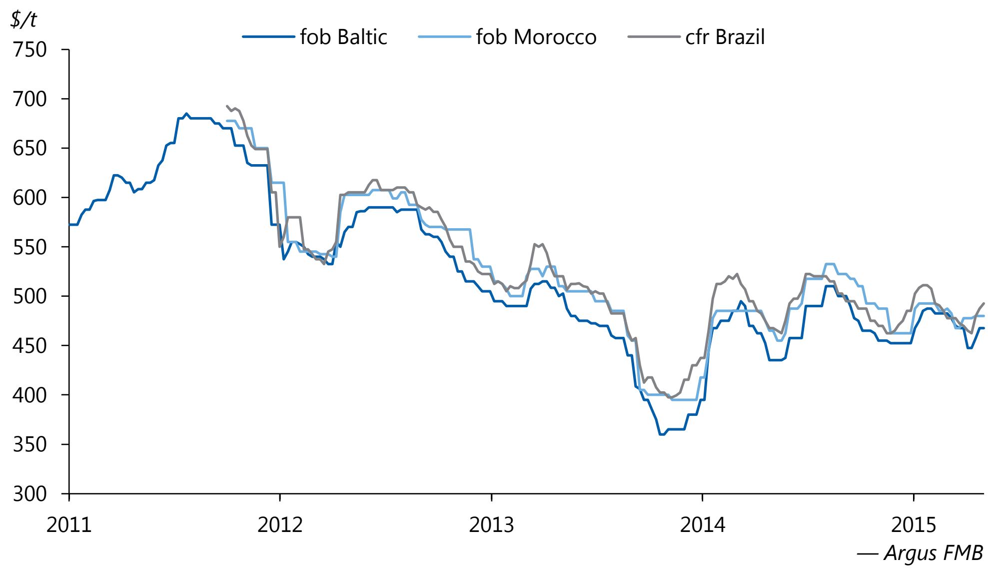


In forecasting Baltic monoammonium phosphate prices, it is assumed that:

- The Baltic diammonium phosphate price is derived from the Moroccan diammonium phosphate price by shaving of $15-20/t;
- The Baltic monoammonium phosphate price will continue to be around $0-5/t below Baltic diammonium phosphate.

From October 2011 to date, Moroccan monoammonium phosphates prices have averaged $15-20/t above the Baltic fob reference, representing the freight differential to the key Brazilian market. A long-term freight rate for the Brazilian cfr price of $15-19/t relative to Morocco is then assumed.

Figure 2-10: Baltic, Morocco and Brazil MAP prices



The above assumptions and the base case for Moroccan diammonium phosphate prices lead to the following projections for monoammonium phosphates to 2029:

Table 2-4: Baltic MAP fob Price Forecasts to 2029					$/t
	DAP		MAP		
	fob Morocco	fob Baltic	fob Baltic	fob Morocco	Brazil cfr
2004 actual	233	216	216		
2005 actual	260	238	235		
2006 actual	266	248	246		
2007 actual	431	419	415		
2008 actual*	984	944	955		
2009 actual*	343	328	330		
2010 actual	503	490	491		
2011 actual	656	632	633		
2012 actual	567	556	558	575	576
2013 actual	475	459	475	473	481
2014 actual	504	479	467	488	491
2015	500	482	468	494	487
2016	472	454	452	469	485
2017	461	443	441	458	474
2018	452	434	431	449	465
2019	485	467	464	482	498
2020	506	488	485	503	519
2021	526	508	506	523	540
2022	532	514	512	529	547
2023	538	520	518	535	553
2024	544	526	524	541	559
2025	550	532	530	547	565
2026	556	538	536	553	572
2027	562	544	542	559	578
2028	568	550	548	565	584
2029	574	556	554	571	591

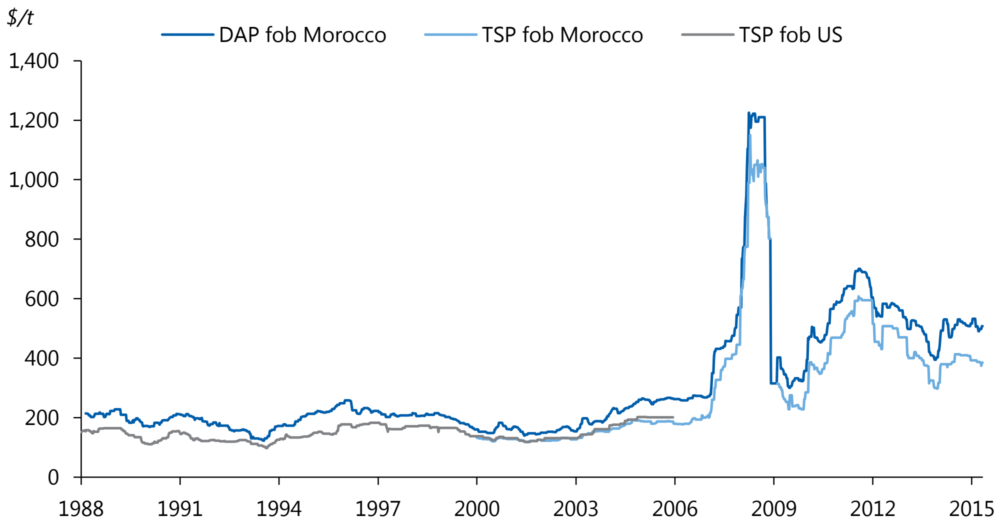
**estimated prices are used for the period 4Q08 to Feb 2009 where no market prices were reported*

— Argus Consulting

Chapter 3: Triple Superphosphate Prices

The graph below presents the price of triple superphosphate ex-US Gulf and ex-Morocco versus Morocco diammonium phosphate fob prices. In the case of triple superphosphate fob US Gulf, FMB ceased to report this price in mid-2006 with the closure of Mosaic's South Pierce plant, and for much of 2005 the price was no longer a good indicator of spot market conditions. Nevertheless, given the very close relationship between Morocco and US triple superphosphate prices, since the former was first reported in 2000, it is possible to draw some clear conclusions about the long-term linkages between diammonium phosphate and triple superphosphate prices.

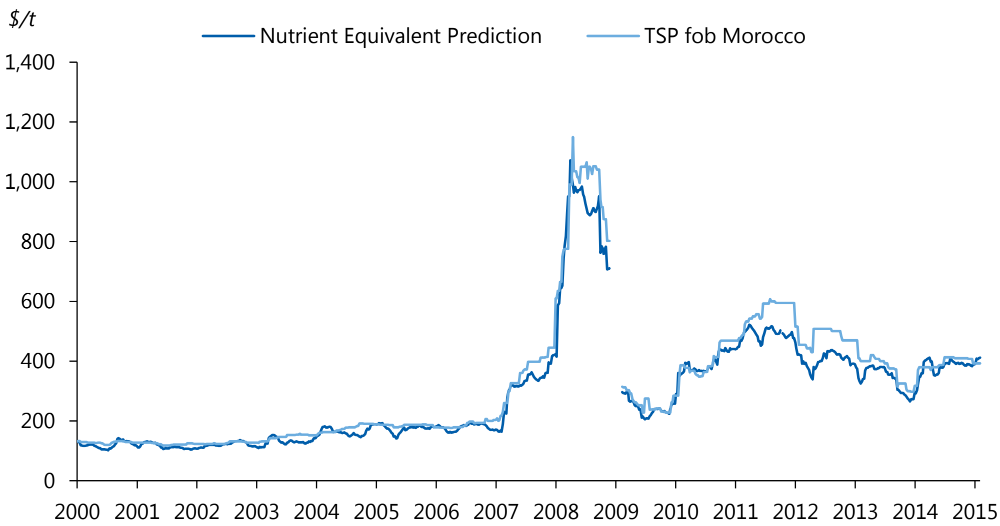
Figure 2-11: TSP versus DAP prices



— *Argus FMB*

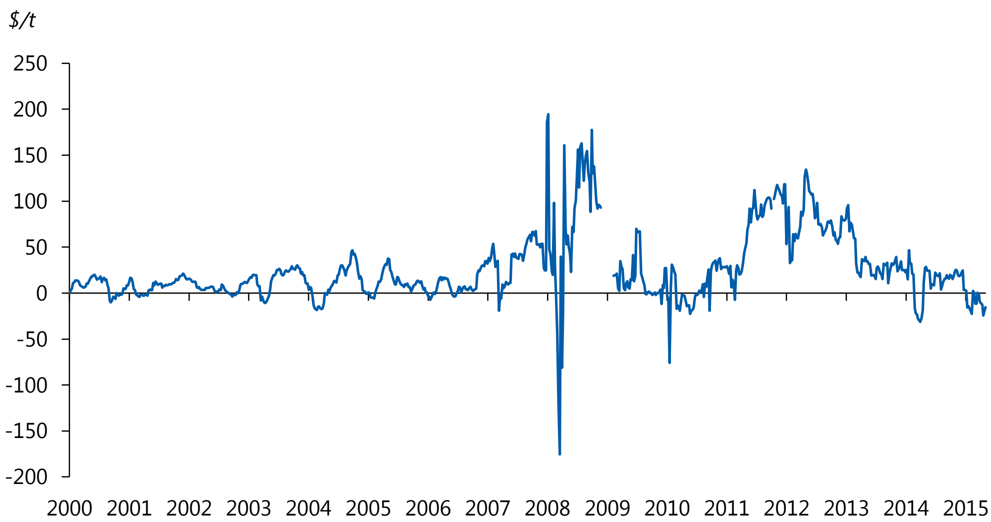
Since diammonium phosphate and triple superphosphate are high-analysis phosphate fertilizers with a P_2O_5 content of 46pc, the key difference in pricing would be expected to amount to a premium to reflect the N content of DAP. By taking away a simple proxy for this, namely the price of urea based on the Yuzhny fob prilled benchmark, an estimate for triple superphosphate prices can be derived that closely reflects the actual historic price of triple superphosphate. The average differential between the actual and predicted price since 2000 has grown from $0-10/t in 2000-06, to $30-40/t in 2007, and has since swung markedly reflecting periods of relative tightness in the phosphates market compared with urea, such as 2011 and the second quarter of 2012, when the differential rose to $100-130/t. In 2013, the relative flatness of the phosphates market has seen the premium fall back down to $30-40/t, a downward trend which continued in 2014 with the differential averaging $10-15/t.

Figure 2-12: TSP Prices — Nutrient Equivalent Prediction versus Actual



— *Argus FMB*

Figure 2-13: TSP Prices — Nutrient Equivalent Prediction versus Actual



— *Argus FMB*

It is assumed that the long-term premium OCP will earn for triple superphosphate in relation to the nutrient equivalent prediction will be in the $35-40/t range. As such the forecast for Moroccan diammonium phosphate prices and the long-term outlook for Black Sea urea prices are used to generate a forecast for triple superphosphate. The resulting price forecast is presented below:

Table 2-5: TSP Price Forecast to 2029			$/t
	DAP	Urea	TSP
	fob Morocco	fob Yuzhny prilled	fob Morocco
2004 actual	233	177	175
2005 actual	260	218	186
2006 actual	266	224	187
2007 actual	431	305	349
2008 actual*	984	497	900
2009 actual*	343	250	283
2010 actual	503	288	394
2011 actual	656	425	555
2012 actual	567	410	483
2013 actual	475	341	377
2014 actual	504	319	392
2015	500	291	423
2016	472	240	416
2017	461	245	403
2018	452	250	392
2019	485	260	421
2020	506	320	418
2021	526	335	433
2022	532	358	430
2023	538	364	433
2024	544	371	436
2025	550	378	440
2026	556	384	443
2027	562	391	447
2028	568	398	450
2029	574	405	454

**estimated prices are used for the period 4Q08 to Feb 2009 where no market were prices reported*

— Argus Consulting

Chapter 4: Single Superphosphate Prices

Forecasting single superphosphate prices is complicated by the following:

- *Argus* FMB does not currently have a quoted price for single superphosphate and even in Brazil, the main market for single superphosphate, there are no regularly published prices;
- In terms of international trade, single superphosphate of various grades and qualities is sold on the market. In the case of Brazil, there are at least four product grades marketed:

  0-18-0
  0-19-0
  0-20-0
  3-17-0

On the other hand, the general rule for the price of granular single superphosphate taking the example of an average 19pc P_2O_5 in Brazil is:

SSP = TSP pro rata (19/46) + 10-25pc

The premium over triple superphosphate (46pc P_2O_5) varies according to the market situation. The premium reflects the perceived better performance of single superphosphate in Brazil. This is derived from the cocktail of sulphur, calcium and other minerals and trace elements in single superphosphate that, unlike triple superphosphate, have not been filtered out during the production process. Conversely, depending on the rock used, single superphosphate can also contain unwanted elements such as cadmium and chlorine and unwelcome radioactivity.

The following methodology has been adapted to derive a price forecast for single superphosphate:

- The forecast for triple superphosphate based on the *Argus* FMB fob Morocco price reference is utilised. A notional cfr south Brazil single superphosphate is then derived by incorporating the long-term freight rate assumption for the typical 30,000-40,000 dead weight tonne (dwt) class of vessel used to move DAP/MAP/TSP from Morocco to south Brazil. This is around $15-19/t over the long term;
- The cfr south Brazil TSP price is incorporated into the above formula, using an average premium of 17.5pc, to derive a long-term forecast for a notional good-quality granular single superphosphate (19pc) cfr south Brazil.

The resulting price forecast for granular SSP prices to 2029 is presented below:

Table 2-6: SSP Price Forecast to 2029			$/t
	TSP	TSP	GSSP 19pc
	fob Morocco	Cfr South Brazil	Cfr South Brazil
2012 actual	483		
2013 actual	377		
2014 actual	392		
2015	423	438	213
2016	416	431	209
2017	403	419	203
2018	392	408	198
2019	421	437	212
2020	418	435	211
2021	433	450	218
2022	430	447	217
2023	433	451	219
2024	436	454	220
2025	440	458	222
2026	443	462	224
2027	447	465	226
2028	450	469	228
2029	454	473	230

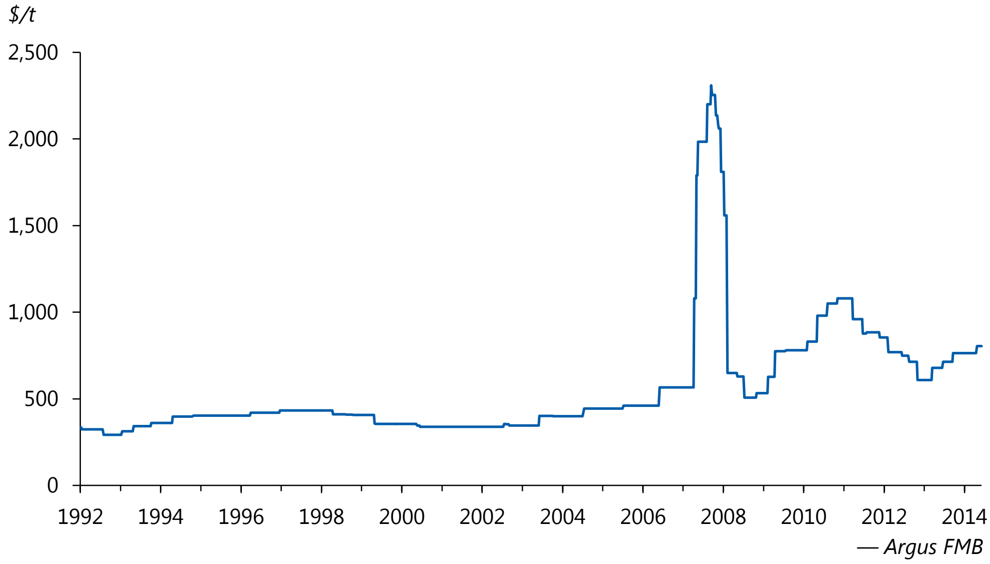
— Argus Consulting

Chapter 5: Phosphoric Acid Prices

Merchant grade phosphoric acid is nearly all consumed in fertilizer manufacture, although some is purchased and purified and Foskor product can be used directly in STTP. Price discovery in this market is becoming increasingly difficult:

- Trade is dominated by a few participants with an ever smaller volume of spot tonnage, with Morocco accounting for almost half of exports and India accounting for half of imports;
- Historically, India has negotiated an annual contract price for its requirements. However, in February 2009, after protracted negotiations, a first-quarter phosphoric acid price was established without an agreement for the second quarter. This represented the first signal of a switch away from long-term contracts. After a recovery in pricing in 2009, following the 2008 crash, 2010 and 2011 saw phosphoric acid contract prices continue to rise in line with the strong rise in phosphates demand and therefore diammonium phosphate prices. By the fourth quarter of 2011, cfr India contract prices had reached $1,080/t cfr India. The subsequent downturn in phosphates demand and reduction in diammonium phosphate prices pulled phosphoric acid down to reach an underpriced low of $609/t in the fourth quarter of 2013, before recovering to $765/t in the fourth quarter of 2014, $805/t in the first half of 2015 and $810/t in the second half of 2015;
- US exports are declining. It should be noted that, while FMB has traditionally quoted a US Gulf coast price, exports from this area have now all but ended. PCS is the only exporter of phosphoric acid with product from the company's Moorehead City complex in North Carolina. Export sales, which totalled 400,000-500,000t P_2O_5 t/yr in 2007-12, mostly serve Mexico and India and are on a contract basis. The closure of the PCS Suwannee unit will lead to a net loss of 215,000t of acid according to the company and an assumed equivalent decline in exports to India (IFFCO and Coromandel);
- Where there is investment in new phosphoric acid capacity for export, this tends to be associated with joint-venture projects with Indian companies. OCP started supplying the Fertiberia Huelva unit with phosphoric acid in the first quarter of 2011, but this represented a switch from a long-term phosphate rock supply contract and, as previously noted, has since been replaced by DAP imports;
- China's fragmented exports of 200,000-300,000 t/yr of acid are assumed to decline in the long-term.

Figure 2-14: Phosphoric Acid Prices cfr India



Historically, cycles in phosphoric acid have tended to follow those of phosphate fertilizers, but at the same time have been heavily influenced by changes in policy in India, which have led to a significant impact on purchasing from year to year. This situation has changed with the consolidation in market control on the part of suppliers.

The table below provides a base forecast for phosphoric acid prices to 2029 following the below methodology:

- A "value" approach is largely adopted, the starting point being the fob Morocco diammonium phosphate benchmark;
- The base diammonium phosphate price forecast builds in a long-term structural adjustment driven by a long-term upward shift in the price of ammonia and sulphur and, more significantly, also by the evolution of a market control margin given the influence that OCP can now wield over the global phosphates market;
- From the fob Moroccan diammonium phosphate benchmark a cfr contract price is derived for the key phosphate import market, India. Because India offers a significant base load for the major diammonium phosphate exporters, the long-term assumption is for this cfr price to include a 5pc discount against the spot fob Moroccan price;
- The benchmark urea price forecast (fob Yuzhny) is used to generate a cfr India value for the nitrogen component of diammonium phosphate. The value for the phosphates component is expressed as the cfr India phosphoric acid equivalent being derived from the residual, after subtracting the nitrogen value from the diammonium phosphate price.

This methodology appears to roughly underpin contract pricing for phosphoric acid in India, again with the exception of the very low negotiated price of $609/t cfr in the fourth quarter of 2013. The 2014 Indian negotiated contract saw an upward correction and averaged $712/t for the full year, about $20/t higher than the price derived from the phosphates' equivalent value to diammonium phosphate.

The resulting price forecast to 2029 is presented below:

Table 2-7: Phosphoric Acid Price Forecast to 2029 *$/t*

	DAP fob Morocco	DAP cfr India	Urea fob Yuzhny	Urea cfr India	Nitrogen Value of DAP cfr India	Phosphoric Acid cfr India
2004 actual	233		177			383
2005 actual	260		218			425
2006 actual	266		224			454
2007 actual	431		305			532
2008 actual*	984		497			1682
2009 actual*	343		250			590
2010 actual	503		288			748
2011 actual	656		425			983
2012 actual	567	597	410			924
2013 actual	475	491	341			716
2014 actual	504	459	319			712
2015	500	480	291	336	131	808
2016	472	485	240	286	112	811
2017	461	481	245	292	114	798
2018	452	473	320	367	144	716
2019	485	505	260	308	121	836
2020	506	526	320	369	144	829
2021	526	546	335	385	151	860
2022	532	552	358	408	160	853
2023	538	559	364	416	163	861
2024	544	565	371	424	166	868
2025	550	572	378	431	169	876
2026	556	578	384	439	172	884
2027	562	585	391	447	175	892
2028	568	592	398	454	178	900
2029	574	599	405	462	181	908

**estimated prices or partial year averages used where no reported prices: DAP fob Morocco 4Q 2008 and Jan 2009 based on estimates*

— Argus Consulting

Appendix A: Phosphate Fertilizer Demand by Key Country

Table A-1: Phosphate Fertilizer Demand by Key Country, 2000-29 *mn t P_2O_5*

	2000	2009	2010	2011	2012	2014f	2019f	2024f	2029f
World Total	**33.1**	**39.2**	**43.0**	**42.9**	**43.1**	**42.9**	**48.5**	**51.7**	**54.1**
West Europe	**3.6**	**2.4**	**2.6**	**2.5**	2.6	2.7	2.8	2.9	2.9
France	0.8	0.4	0.5	0.5	0.5	0.4	0.4	0.4	0.4
Germany	0.4	0.2	0.3	0.2	0.3	0.3	0.3	0.3	0.3
Italy	0.5	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Poland	0.3	0.4	0.4	0.4	0.3	0.4	0.4	0.4	0.4
Spain	0.6	0.3	0.4	0.4	0.4	0.4	0.5	0.5	0.5
United Kingdom	0.3	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Other	0.8	0.6	0.6	0.7	0.7	0.8	0.9	1.0	1.0
East Europe/Central Asia	**1.3**	**1.7**	**1.6**	**1.7**	**1.8**	**2.0**	**2.5**	**2.9**	**3.2**
Russia	0.3	0.5	0.5	0.5	0.6	0.6	0.8	0.9	1.1
Turkey	0.6	0.6	0.5	0.5	0.5	0.5	0.5	0.5	0.5
Other	0.4	0.6	0.6	0.7	0.7	0.8	1.2	1.4	1.5
Africa	**0.9**	**1.0**	**1.0**	**1.1**	**1.1**	**1.3**	**1.8**	**2.3**	**2.8**
Egypt	0.2	0.2	0.2	0.2	0.2	0.1	0.2	0.3	0.4
South Africa	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2	0.2
Other	0.6	0.6	0.7	0.7	0.7	1.0	1.5	1.9	2.3
North America	**4.5**	**4.3**	**4.6**	**4.7**	**4.7**	**4.3**	**4.9**	**4.9**	**4.9**
Canada	0.6	0.6	0.7	0.8	0.8	0.8	0.8	0.8	0.8
United States	3.9	3.7	3.9	3.9	3.8	3.5	4.1	4.1	4.1
Latin America	**4.0**	**4.2**	**5.2**	**6.1**	**6.4**	**6.6**	**7.4**	**8.1**	**8.8**
Argentina	0.3	0.5	0.6	0.7	0.6	0.7	0.8	1.1	1.3
Brazil	2.7	2.8	3.5	4.2	4.6	4.7	5.1	5.4	5.7
Colombia	0.1	0.2	0.2	0.2	0.2	0.2	0.2	0.3	0.3
Mexico	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.3	0.4
Other	0.6	0.5	0.6	0.7	0.7	0.8	0.9	1.0	1.2
Middle East	**0.8**	**0.6**	**0.6**	**0.3**	**0.3**	**0.5**	**0.6**	**0.8**	**0.8**
Iran	0.4	0.4	0.3	0.1	0.2	0.4	0.4	0.4	0.5
Other	0.4	0.2	0.2	0.2	0.2	0.1	0.2	0.3	0.4
South Asia	**5.3**	**8.5**	**9.3**	**9.0**	**8.0**	**7.3**	**9.7**	**10.9**	**11.3**
Bangladesh	0.3	0.3	0.4	0.5	0.5	0.5	0.6	0.6	0.7
India	4.3	7.3	8.0	7.8	6.7	5.8	8.1	9.0	9.3
Pakistan	0.7	0.9	0.8	0.6	0.7	0.8	0.9	1.0	1.1
Other	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2	0.2
South East Asia	**1.6**	**1.7**	**1.8**	**2.0**	**2.3**	**2.0**	**2.4**	**2.6**	**2.9**
Indonesia	0.3	0.6	0.5	0.6	0.7	0.6	0.7	0.7	0.8
Malaysia	0.3	0.2	0.3	0.3	0.3	0.3	0.3	0.3	0.3
Philippines	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.2	0.2
Thailand	0.4	0.2	0.3	0.4	0.4	0.4	0.5	0.6	0.6
Vietnam	0.5	0.6	0.7	0.7	0.7	0.7	0.7	0.8	0.8
Other	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1
East Asia	**9.5**	**13.7**	**15.1**	**14.1**	**14.9**	**15.0**	**15.0**	**15.0**	**15.0**
China	8.7	13.2	14.5	13.6	14.4	14.5	14.5	14.5	14.5
Japan	0.6	0.3	0.4	0.4	0.4	0.3	0.3	0.3	0.3
South Korea	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Other	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Oceania	**1.6**	**1.0**	**1.2**	**1.4**	**1.1**	**1.3**	**1.3**	**1.4**	**1.5**
Australia	1.1	0.6	0.8	0.9	0.8	0.9	1.0	1.0	1.0
New Zealand	0.5	0.3	0.3	0.6	0.3	0.3	0.4	0.4	0.4

— Historical figures IFA/Argus FMB; Forecasts Argus FMB

Appendix B: DAP and MAP Capacity Changes, 2008-22

Table B-1: DAP and MAP Capacity Changes, 2008-22 *'000 t product /yr*

				2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
DAP																		
World Total				**985**	**906**	**2,370**	**2,305**	**3,140**	**3,050**	**2,890**	**585**	**1,805**	**2,260**	**1,370**	**1,240**	**310**	**310**	**607**
West Europe				260	-	-	-	-	-250	-80	-	-	-	-	-	-	-	-
West Europe	Bulgaria	Agropolychim	Devnya	260	-	-	-	-	-	-	-	-	-	-	-	-	-	-
West Europe	Spain	Fertiberia	Huelva	-	-	-	-	-	-250	-80	-	-	-	-	-	-	-	-
EECA				-	150	-	-	-	-	-	-	-	-	-	-	-	-	-
EECA	Russia	Eurochem	Kingisepp	-	150	-	-	-	-	-	-	-	-	-	-	-	-	-
Africa				0	0	400	500	0	680	680	930	1,240	310	620	1,240	310	310	607
Africa	Gabon	OCP/Gabon JV	Port Gentil	-	-	-	-	-	-	-	-	-	-	-	620	-	-	-
Africa	Morocco	OCP	Jorf Lasfar 6&7	-	-	400	500	-	-	-	-	-	-	-	-	-	-	-
Africa	Morocco	OCP	Jorf Lasfar 8&9	-	-	-	-	-	680	680	-	-	-	-	-	-	-	-
Africa	Morocco	OCP	JPH	-	-	-	-	-	-	-	930	1,240	310	620	620	310	310	310
Africa	Morocco	OCP	SPH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	297
North America				-	-	-	- 495	-	-	-	- 850	-	-	-	-	-	-	-
North America	US	Agrifos	Pasadena, Tx	-	-	-	- 495	-	-	-	-	-	-	-	-	-	-	-
North America	US	MissPhos	Pascagoula		-	-	-	-	-	-	- 850	-	-	-	-	-	-	-
North America	US	Mosaic - conv. to MES	Bartow, Fl	-	-	-	-	-	-910	-	-	-	-	-	-	-	-	-
North America	US	Mosaic – conv. to MES	New Wales, Fl	-	-	-	-	-	-	-	-	-1,300	-	-	-	-	-	-
North America	US	Mosaic – conv. to MES	Riverview, Fl	-	-	-	-	-	-600	-	-	-	-	-	-	-	-	-
North America	US	Mosaic – conv. to MES	Faustina, LA	-	-	-	-	-	-800	-	-	-	-	-	-	-	-	-
North America	US	Mosaic – MES	All sites	-	-	-	-	-	2,310	-	-	1,300	-	-	-	-	-	-
Latin America				-	-	-	-	-	-	250	-	-	-	-	-	-	-	-
Latin America	Venezuela	Pequiven	Moron	-	-	-	-	-	-	250	-	-	-	-	-	-	-	-
Middle East				-	-	100	400	1,200	900	500	-	-	750	750	-	-	-	-
Middle East	Jordan	JPMC	Aqaba	-	-	100	100	-	-	-	-	-	-	-	-	-	-	-
Middle East	Saudi Arabia	Ma'aden	Raz al Khair	-	-	-	300	1,200	900	500	-	-	-	-	-	-	-	-
Middle East	Saudi Arabia	Mosaic/ Ma'aden JV	Raz al Khair	-	-	-	-	-	-	-	-	-	750	750	-	-	-	-
South Asia				305	236	-	-	-	-	-	-	-	-	-	-	-	-	-
South Asia	Bangladesh	Bangladesh Chemical Industry Co	Chittagong	250	-	-	-	-	-	-	-	-	-	-	-	-	-	-
South Asia	Pakistan	Fauji	Port Qasim	55	236	-	-	-	-	-	-	-	-	-	-	-	-	-
South East Asia				-	200	130	-	-	-	-	165	165	-	-	-	-	-	-
South East Asia	Vietnam	Vinachem	Hai Phong, Dinh Vu	-	200	130	-	-	-	-	-	-	-	-	-	-	-	-
South East Asia	Vietnam	Vinachem	Lao Cai Province	-	-	-	-	-	-	-	165	165	-	-	-	-	-	-
East Asia				420	320	1,740	1,860	1,940	1,720	1,540	340	400	1,200	-	-	-	-	-
East Asia	China	Various		420	320	1,740	1,860	1,940	1,720	1,540	340	400	1,200	-	-	-	-	-
Oceania				-	-	-	40	-	-	-	-	-	-	-	-	-	-	-
Oceania	Australia	Incitec-Pivot	Phosphate Hill	-	-	-	40	-	-	-	-	-	-	-	-	-	-	-

Table B-1: DAP and MAP Capacity Changes, 2008-22 *'000 t product /yr*

				2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022
MAP																		
World Total				**1,305**	**420**	**1,868**	**995**	**1,335**	**1,140**	**1,960**	**480**	**640**	**1,140**	**820**	**320**	**710**	**475**	**313**
West Europe				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
EECA				-	-85	-	-	-	-	-	-	-	-	-	-	-	-	-
EECA	Belarus	Gomel Complex	Gomel	-	-85	-	-	-	-	-	-	-	-	-	-	-	-	-
Africa				-	-	-	330	70	170	170	480	640	160	320	320	320	160	313
Africa	Gabon	OCP/Gabon JV	Port Gentil	-	-	-	-	-	-	-	-	-	-	-	320	-	-	-
Africa	Morocco	JFC	Jorf Lasfar	-	-	-	330	70	-	-	-	-	-	-	-	-	-	-
Africa	Morocco	OCP	Jorf Lasfar 8&9	-	-	-	-	-	170	170	-	-	-	-	-	-	-	-
Africa	Morocco	OCP	JPH	-	-	-	-	-	-	-	480	640	160	320	-	320	160	160
Africa	Morocco	OCP	SPH	-	-	-	-	-	-	-	-	-	-	-	-	-	-	153
North America				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
North America	US	Mosaic	Riverview, Fl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Latin America				105	105	78	75	75	-	-	-	-	-	-	-	390	315	-
Latin America	Brazil	Vale	Uberaba, MG	-	-	-	75	75	-	-	-	-	-	-	-	-	-	-
Latin America	Brazil	Anglo American	Catalao, Goias	-	-	-	-	-	-	-	-	-	-	-	-	325	250	-
Latin America	Brazil	Galvani	Serra do Satlitre, MG	-	-	-	-	-	-	-	-	-	-	-	-	65	65	-
Latin America	Mexico	Lazaro Cardenas		105	105	78	-	-	-	-	-	-	-	-	-	-	-	-
Middle East				-	-	-	-	-	-	-	-	-	500	500	-	-	-	-
Middle East	Saudi Arabia	Mosaic /Ma'aden JV	Raz al Khair	-	-	-	-	-	-	-	-	-	500	500	-	-	-	-
East Asia				1,200	400	1,750	590	1,190	970	1,790	-	-	480	-	-	-	-	-
East Asia	China	Various		1,200	400	1,750	590	1,190	970	1,790	-	-	480	-	-	-	-	-
Oceania				-	-	40	-	-	-	-	-	-	-	-	-	-	-	-
Oceania	Australia	Incitec-Pivot	Phosphate Hill	-	-	40	-	-	-	-	-	-	-	-	-	-	-	

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