PHOSPHATE ROCK

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Phosphorus is an essential element for plant and animal nutrition. Most phosphorus is consumed as a principal component of nitrogen-phosphorus-potassium fertilizers (NPK) used on food crops throughout the world. Phosphate rock minerals are the only significant global resources of phosphorus.

The United States is the world's leading producer and consumer of phosphate rock. Approximately 93% of the phosphate rock mined was used to produce chemical fertilizers and animal feed; the remainder was used to produce elemental phosphorus and other industrial phosphates. In 1999, production in Florida and North Carolina reached its lowest level since 1993. Fertilizer demand in the East and Midwest was down because of wet weather during the spring planting season and low crop prices that reduced the total crop acreage planted. In addition, exports of phosphate fertilizers began the year at a slower pace than in 1998. This resulted in fertilizer inventories, primarily diammonium phosphate (DAP), reaching levels more than 50% higher than in 1998 by midyear (The Fertilizer Institute, 1999). The excessive inventories, combined with the impact of actual and anticipated foreign capacity expansion, caused prices to plummet. Beginning in July, companies began to close mines and plants in an effort to reduce inventories and stabilize prices. Producers in the Western United States were mostly unaffected by the market situation because their products are sold on a regional basis. Total domestic production of marketable phosphate rock decreased 8%, owing to the closure of several mines and associated phosphoric acid manufacturing facilities.

Phosphate rock was produced by 11 companies at 18 mines; 12 mines in Florida and 1 in North Carolina accounted for 86% of domestic production. Phosphate rock also was used to manufacture high-analysis phosphate fertilizers, elemental phosphorus (P_4), and phosphorus compounds. Two companies in Idaho produced P_4 for downstream industrial products.

In the United States, marketable phosphate rock consumption decreased 3% from that of 1998. U.S. phosphate rock sold or used by producers decreased 5% to 41.6 million metric tons (Mt). Imports of phosphate rock reached a record high of 2.17 Mt, owing to an increase in fertilizer production capacity by the major importer. The U.S. Department of Commerce reported that wet-process phosphoric acid (WPPA) production was 12.3 Mt as available phosphorus pentoxide (P_2O_5) (Bureau of the Census, 2000), which represented an industry-operating rate of 93% (International Fertilizer Development Center, 1999). The United States accounted for more than 50% of global trade of converted phosphate products. The major products in order of importance were DAP, Monoammonium phosphate (MAP), granular triple superphosphate (TSP), and WPPA.

Legislation and Government Programs

Phosphoric acid was removed from the list of chemicals in the U.S. Environmental Protection Agency (EPA) Toxic Release Inventory (TRI) following a ruling issued by the U.S. District Court for the District of Columbia. The presiding judge agreed with an argument by The Fertilizer Institute (TFI) that phosphoric acid is nontoxic. TFI had initially petitioned the EPA in 1990 to remove phosphoric acid from the TRI; however, the EPA denied the request in 1998, which resulted in TFI suing the EPA. Because of the ruling, companies will no longer be required to report releases of phosphoric acid (Green Markets, 1999g).

The EPA revised the National Emission Standard for Hazardous Air Pollutants, which set limits on radon emissions from phosphogypsum stacks. The new regulation contained three major provisions: (1) the maximum quantity of phosphogypsum that may be used for indoor research and development was raised from 317.5 kilograms (kg) to 3,175 kg, (2) the sampling requirement for Ra-226 for indoor research was eliminated, and (3) sampling procedures for phosphogypsum removed from stacks for other purposes were modified to include indoor research and development activities, such as the study of using phosphogypsum as a road base or for other uses approved by the EPA on a case-by-case basis. Phosphogypsum will still be permitted to be used as a soil amendment if the Ra-226 concentration is less than 10 pico-curies per gram (U.S. Environmental Protection Agency, 1999).

The EPA issued a final ruling that requires manufacturers of phosphoric acid and phosphate fertilizers to control emissions of hydrogen fluoride (HF) and heavy metals. The EPA set emission reduction levels for HF of 310 metric tons per year (t/yr) and 940 t/yr for total fluorides containing heavy metal particulate matter. The Agency expected that HF emissions could be reduced by up to 60% per facility (Green Markets, 1999a).

Production

Domestic phosphate rock production data were developed by the U.S. Geological Survey from monthly and semiannual voluntary surveys of producers of phosphate rock. All 11 companies responded to the canvass, which represented 100% of U.S. production.

Production in the Florida-North Carolina region fell 10% owing to a drop in fertilizer production (tables 1 and 3). Wet

weather during the spring planting season and low crop prices, which lowered the total crop acreage planted, caused demand in the East and Midwest to drop. In addition, exports of phosphate fertilizers started the year at a slower pace than in 1998, and there was concern about the effect of actual and foreign capacity expansions. Stocks of DAP, the major fertilizer product, increased rapidly, resulting in a substantial drop in prices. As companies sought to reduce inventory and stabilize prices, several mines and fertilizer facilities were closed in the last half of the year. U.S. mine production capacity fell from 55 million metric tons per year (Mt/yr) to 43.3 Mt/yr (table 13). Output from Idaho and Utah increased, as regional demand remained strong.

Southern States.—In Florida, phosphate rock was mined and processed by six companies: Agrifos, L.L.C.; Cargill Fertilizer, Inc.; CF Industries, Inc.; IMC-Agrico Co.; Nu-Gulf Industries, Inc.; and PCS Phosphate Co., Inc. Their mines and plants were in Hamilton, Hardee, Hillsborough, Manatee, and Polk Counties (table 2). U.S. Agri-Chemicals Corp. and Farmland Hydro, L.P., a joint venture between Farmland Industries, Inc. and Norsk Hydro ASA, operated WPPA and ammonium phosphate plants at Fort Meade and Green Bay respectively, using phosphate rock purchased from other companies in Florida. Farmland Hydro was planning to submit an application for a permit to open a mine in Hardee County in the first half of 2000. The company plans to commission the mine about four years after receiving the permit (Custred, 2000).

Six concentrated phosphate plants were located along the Gulf of Mexico. IMC-Agrico operated facilities in Louisiana at Faustina, Taft, and Uncle Sam using phosphate rock from the firm's mines in Florida. The PCS Nitrogen Inc. plant in Geismar, LA, and Mississippi Phosphates Corp. plant in Pascagoula, MS, both used phosphate rock imported from Morocco. The Agrifos L.L.C. plant in Pasadena, TX, used both phosphate rock from the company's Nichols Mine in Florida and imports from Morocco.

IMC-Agrico, which is a joint venture between IMC Global Inc. and Phosphate Resource Partners, L.P., permanently closed two mines; Payne Creek, because of market conditions and Noralyn-Clear Springs, which had exhausted its reserves. This reduced the firm's annual mine production capacity by 25% and the number of operating mines to four (IMC Global, 1999b). The company received approval from the Florida Department of Environmental Protection to expand its Four Corners Mine by 7 hectares (ha) and continued the process to obtain permits for two new mines, Ona, which would be in Hardee County, and Pine Level, which would be in DeSoto and Manatee Counties (Green Markets, 1999e). The permit for Ona will be submitted in the first half of 2000 and for Pine Level in mid-2001. The company stated that it would only mine on 76% of the land at the Ona site, to preserve part of the natural habitat (Green Markets, 1999d).

IMC Global, the majority partner the IMC-Agrico, signed a new 20-year agreement to supply phosphate rock to U.S. Agri-Chemicals, a wholly owned subsidiary of China National Chemicals Import and Export Corporation. The new contract will extend from the end of the current contract, September 30, 2004, to September 20, 2024 (IMC Global, 1999a). IMC Global sold 6,800 ha of previously mined land that was part of the closed Clear Springs and Noralyn Mines to a Connecticut company. Development of the land will not begin until IMC-Agrico finishes reclamation procedures in 3 to 4 years (Green Markets, 1999f).

In response to the market conditions, IMC-Agrico made several reductions in fertilizer production capacity, by permanently closing the Nichols, FL, phosphoric acid/DAP/MAP plant and temporarily closing the Taft and Faustina, LA, DAP/MAP plants. The two facilities in Louisiana were not expected to operate in 2000. Its New Wales, FL, plant was expected to permanently halt TSP production in early 2000 (IMC Global Inc., 2000).

Nu-Gulf Industries produced phosphate rock at the Wingate Creek Mine in Manatee County, FL, for use by Mulberry Phosphates, Inc. and Piney Point Phosphates, Inc. to manufacture phosphoric acid and DAP; all three companies were subsidiaries of the Mulberry Corporation. The Piney Point plant reopened in July after a 7-year shutdown; however, it was closed again in October because of poor market conditions (Fertilizer Markets, 1999c). Mulberry was forced to close the Wingate Creek Mine and Mulberry plant in December after export sales decreased and it was unable to operate profitably (Green Markets, 2000c).

PCS Phosphates, a subsidiary of Potash Corporation of Saskatchewan Inc. (PCS), operated the Aurora Mine and associated phosphoric acid and granulation plants in Beaufort County, NC. Output from the Aurora Mine was down from 1998, because the company's mining permit required that it had to extract ore from an area of the deposit that had a lower P_2O_5 content, which caused processing difficulties. PCS made several reductions in fertilizer production capacity at its Suwannee River, FL, facility. In response to the market conditions, it closed the hemihydrate phosphoric acid plant, ceased production of DAP, and reduced the output of P_2O_5 for the export market. These actions dropped the company's annual P_2O_5 output by 200,000 metric tons (t) and DAP output by 275,000 t (Potash Corporation of Saskatchewan Inc., 1999). In addition, PCS closed its Jacksonville, FL, terminal and consolidated phosphate export operations at its existing Morehead City, NC, terminal (Fertilizer Markets, 1999d).

Cargill closed its phosphate mines for the last two weeks of December to reduce stocks and the operating rates at its fertilizer plants in the last quarter (Fertilizer Markets, 1999a). Other producers also made some less severe reductions in output.

Idaho and Utah.—In Idaho, four companies conducted open pit mining in Caribou County. FMC Corporation operated the Dry Valley Mine on Federal and private leases, to provide feedstock for P_4 production at its Pocatello plant. P4 Production, L.L.C, a joint venture between Solutia Inc. and Monsanto Co., produced phosphate rock from the Enoch Valley Mine for P_4 production at the Solutia Soda Springs, ID, plant. Agrium Inc. produced phosphate rock from the Rasmussen Ridge Mine to feed its Conda WPPA and DAP plants. Simplot operated the Smoky Canyon Mine, which supplied its WPPA plant in Pocatello, via a 138-kilometer (km) slurry pipeline.

In April, FMC and Solutia entered into a joint-venture

agreement to combine the phosphorus chemical operations of both companies. The new company, Astaris LLC, will be headquartered in St. Louis, MO, and operate 11 plants in 7 States and 1 plant in Brazil. The FMC plants were in Lawrence, KS; Carteret, NJ; Kemmerer and Green River, WY; Pocatello, ID; and Dry Valley, ID. The Solutia plants were located in Augusta, GA; Carondelet, MO; Ontario, CA; Trenton, MI; Sauget, IL; and Sao Jose dos Camps, Brazil. Solutia will provide elemental phosphorus from its Soda Springs, ID, facility; its 40% interest in a joint venture with Monsanto is not included in Astaris (Solutia Inc., 1999). The U.S. Federal Trade Commission approved the Astaris joint venture in April 2000 (Green Markets, 2000b).

In October, FMC announced that it would construct an 80,000-t/yr purified phosphoric acid (PPA) plant near Soda Springs, ID. The facility will be located within the Nu-West Industries (a wholly owned subsidiary of Agrium) Conda phosphate fertilizer plant. Under the agreement, Nu-West will lease and operate the plant and FMC will purchase the PPA under a long-term supply agreement. The new facility will use phosphate rock from the FMC Dry Valley Mine, which also supplies the FMC elemental phosphorus plant in Pocatello. FMC expects to use the PPA to supply Astaris. The project is scheduled to be completed in mid-2001 (FMC Corporation, 1999). FMC anticipates reducing production of elemental phosphorus upon completion of the new plant, by substituting PPA for thermal phosphoric acid. This would enable FMC to meet EPA-mandated emissions reductions at the Pocatello P_4 facility (U.S. Environmental Protection Agency, 2000b).

The U.S. Forest Service and U.S. Bureau of Land Management proposed making two tracts of land in the Caribou National Forest available for competitive bids for phosphate exploration and mining. Mining would not begin until the requirements of the National Environmental Policy Act have been met and site-management plans have been developed and approved (Green Markets, 1999c).

FMC began implementation of waste reduction and remediation plans at its Pocatello P_4 plant, which were required by a 1998 legal settlement with the EPA. FMC completed work toward the closure of several old waste ponds and implementation of a new waste management plan for active waste ponds and submitted a plant for treating phosphorus-containing waste streams. However, in March 2000, it requested a one-year extension because of the lack of available treatment capacity and for additional time to design, construct, and begin operation of an onsite treatment plant. If granted, the company would have until May 26, 2001, to complete the required tasks (U.S. Environmental Protection Agency, 2000b). In February 1999, the EPA proposed emission limits for air pollution from the facility. After receiving public comments and new technical information, the EPA decided to revise the emission limits. The proposed changes were opened to public comment from January 27 to March 13, 2000 (U.S. Environmental Protection Agency, 2000a). FMC proposed a $190 million facility improvement plan to achieve compliance with the new emissions limits by 2002 (Green Markets, 2000a).

In Utah, SF Phosphates Ltd. Co., a joint venture between J.R. Simplot Co. and Farmland Industries, Inc., operated a major mining and phosphate rock beneficiation facility near Vernal. The beneficiated phosphate rock was transported by a 155-km slurry pipeline to the company's phosphate fertilizer production plant at Rock Springs, WY.

Universal Chemical Corp., of Illinois has proposed to develop a new mine and processing plant near Vernal, UT. The ore would be obtained from the Ashley Valley Phosphate Co., which has 1,370 ha of phosphate reserves adjacent to SF Phosphates. The plant would use a process that treats the phosphate rock with a mildly acid solution to extract the phosphates. The phosphate solution would then be piped to a plant near Bonanza, UT. The waste material would then be dried and backfilled into the mine, thus eliminating the need for clay settling ponds. The main products would be animal feed supplements and fertilizers. According to Universal Chemical, the byproduct phosphogypsum would be free of contaminants, such as heavy metals or radioactive materials, and would be used to manufacture wallboard at an onsite plant. The State of Utah and Uintah County are conducting a study of the proposal and are seeking $1.8 million from the Federal Government to study the feasibility of building a railroad spur that would connect the Uintah basin area with the transcontinental railroad. This would allow the phosphate materials to be transported as far as the Midwest. The plant and mine are proposed to open sometime in 2003, if financing is obtained within the next year (Woolf, Jim, The Salt Lake Tribune, September 5, 1999, Vernal residents weigh prospect of phosphate mine, accessed September 9, 1999, at URL http://www.sltrib.com/1999/sep/09051999/business/20944.htm).

Consumption

In 1999, U.S. sales and use of phosphate rock decreased 5% from that of 1998 (table 4). U.S. producers were affected by a decrease in domestic demand for phosphatic fertilizers during the spring planting season and a concurrent drop in exports. Fertilizer manufacturers east of the Mississippi River were hardest hit because exports are a large percentage of the companies' sales and they account for nearly all fertilizer sales in the East and Midwest. Although exports of fertilizers, primarily DAP and MAP, rebounded in the last half of the year, producers were unable to fully recover from earlier damage. By June, stocks of DAP were up by more than 50% over 1998. Consequently, the price of DAP plummeted and firms began cutting back output in an attempt to reduce stocks. The situation stabilized by the end of the year as fertilizer demand was stronger in the fourth quarter and inventories fell.

Western producers were not affected as severely by the overall market problems, because sales, which are restricted to the region, remained strong. Production of P_4 was estimated to have remained near full capacity of 236,000 t/yr. According to the Bureau of the Census, 240,000 t of thermal phosphoric acid was produced from elemental phosphorus in 1999 (Bureau of the Census, 2000). Exports of P_4 dropped from 8,020 t in 1998 to 5,740 t (table 11). About 65% of P_4 was used to manufacture thermal phosphoric acid, which was used in nonfertilizer applications, such as detergent and food additives, water-and

metal-treatment chemicals, vitamins, soft drinks, toothpaste, photographic film, light bulbs, bone china, optical glass, and other consumer goods. The remainder was used to produce phosphorus trichloride, phosphorus pentasulfide, and other compounds, which were used in herbicides, insecticides, flame retardant chemicals, and plasticizers.

Stocks

U.S. stocks of phosphate rock ended the year down 13% from those of 1998. Stocks in the Florida and North Carolina region fell 20%, while stocks in the Idaho and Utah region increased by 25% (table 3).

Transportation

In Florida, beneficiated phosphate rock was moved by truck and rail to phosphate upgrading facilities. Phosphate rock and finished phosphate materials were sent by rail to ports at Tampa and Jacksonville, and then were shipped for domestic use or exported. About 23 Mt/yr of phosphate-related materials move through the port of Tampa, representing nearly 50% of all shipments (Tampa Port Authority, 1999, Bulk cargo, accessed March 15, 2000, at URL http://www.tampaport.com/bulkcargo.htm).

The Florida Institute of Phosphate Research conducted tests at IMC-Agrico's inactive Fort Lonesome Mine of a magplane system for transporting phosphate rock. The magplane system consists of cylindrical cars that move through a closed 1-meter diameter tube by magnetic levitation at 65 kilometers per hour. The tests demonstrated how the car moved through the tube and loaded and unloaded materials. Estimated operating costs for the magplane were 85% less than using truck or rail. If a large-scale system was to be constructed it could move rock from the mine to processing plant or move fertilizer from the plant to the port. The system also could be used to move coal or other materials from the port of Tampa to the central Florida area, thus recouping some of the cost of operation (Green Markets, 1999b).

Phosphate fertilizers produced by companies along the Gulf of Mexico were transported by barge on the Mississippi River and other major tributaries for domestic consumption. Producers also sent material to consumers by rail and truck. PCS Phosphates operated a port facility at Morehead City, NC, for export and import. PCS closed its Jacksonville, FL, facility late in the year and consolidated shipping operations at Morehead City (Potash Corporation of Saskatchewan Inc. 1999). In the West, phosphate ore was sent from the mine via truck, rail, and slurry pipeline.

Prices

The average price for domestic phosphate rock increased 20% in 1999 (table 5). Changes in accounting procedures by several companies and a tighter domestic supply were responsible for the large increase.

Foreign Trade

Imports of phosphate rock were estimated at 2.17 Mt, with more than 99% from Morocco. Reported imports of phosphate rock were only 745,000 t because some data were suppressed by the Bureau of the Census (table 12). PCS Nitrogen and Mississippi Phosphates used phosphate rock from Morocco in phosphate conversion plants in Geismar, LA, on the Mississippi River and at Pascagoula, MS, on the Gulf of Mexico, respectively. The Agrifos plant in Texas used phosphate rock from Morocco in addition to rock from its mine in Florida.

Phosphate rock exports dropped from 378,000 t in 1998 to a new low of 272,000 t (table 6). The overall industry emphasis has shifted from exporting rock to higher value, high analysis fertilizers, and conserving phosphate rock resources at existing mines.

India and China continued as the main destination for U.S. fertilizer exports, accounting for about 75% of all shipments (tables 7-10). Since 1975, the majority of U.S. phosphate fertilizer export sales have been conducted by PhosChem, which consisted of IMC-Agrico, PCS Phosphate, Mississippi Chemical Corp., and Mulberry Corporation. PhosChem members sell to all countries, except Canada, members of the European Union, and through the United States Agency for International Development. In 1999, 81% of PhosChem sales were to Asia, primarily China and India, 11% to Latin America, and 8% to Oceania (Potash Corporation of Saskatchewan Inc., 2000). Total combined export tonnage increased in 1999, owing to strong sales of DAP and MAP, which overcame lower exports of WPPA and other fertilizer materials.

World Review

World production of phosphate rock was estimated to have decreased by 3 Mt from 1998 (table 14). China, Morocco, and the United States accounted for 64% of total production. New mines opened in Australia and Canada, and production increased in Mexico, Russia, and Senegal. World consumption of phosphate rock was estimated to have increased as several fertilizer joint venture projects in Africa and Asia commenced operation. Fertilizer production, especially DAP, increased substantially owing to capacity expansions at existing plants and the opening of new facilities. China and India remained the largest consumers of phosphate fertilizers, accounting for 54% of world DAP imports. The United States remained the largest supplier to both countries, and reached a record for exports of both DAP and MAP. However, sales were not consistent because the government of India delayed enacting subsidies in the spring, and China reduced its purchases in the second half of the year after its supplies increased.

New DAP plants that were under construction in the Indian subcontinent and Australia caused the price to slip in anticipation of more DAP entering the market, despite an increase in world production and consumption. The total

projected regional capacity increase would be 3.5 to 4.0 Mt of DAP, which would surpass total current imports into the area. The opening of the largest facility, Oswal Chemicals and Fertilizers Ltd. plant, was delayed by damage from a storm that hit the east coast of India in October and caused extensive damage to the facility. It was rescheduled to open in mid-2000.

Australia.—In August, WMC Fertilizers Pty. Ltd. (WMCF) commissioned the Duchess Mine and beneficiation plant in Northwest Queensland. The mine has proven reserves of more than 100 Mt and a production capacity of 2 Mt/yr of marketable rock. It will supply the nearby Phosphate Hill fertilizer complex, which will have a combined DAP/MAP production capacity of 1 Mt/yr (Fertilizer Week, 1999c). The fertilizer plant was commissioned on December 31, 1999, about a month later than planned, because of problems with the ammonia and granulation plants. WMCF plans to produce about 800,000 t of DAP in 2000 and reach full capacity in 2001. Cargill will market up to 500,000 t/yr through 2005 and provide technical advice on the project. The agreement will enable Cargill to increase sales in Asia, where it has expanded and developed plants in China, India, and Thailand. The remaining product will be sold within Australia, greatly reducing the dependence on imports, which have averaged 1.2 Mt/yr, most from the United States (Helleman, 1999).

Canada.—Agrium commenced production of phosphate rock at the Kapuskasing Mine in northern Ontario. The ore was shipped to the company's fertilizer plant in Redwater, Alberta, replacing imported rock from Togo. However, the company had trouble maintaining consistent production levels at the mine. The problems were expected to be resolved in the second quarter of 2000 (Fertilizer Markets, 1999b).

MCK Mining Corp., Toronto, completed an initial study of the Martison phosphate deposit, which is 70 km north of Hearst, Ontario, and 110 km northwest of the Agrium Kapuskasing Mine. According to the company, preliminary results show that the deposit has a resource base of 113 Mt, grading 21.4% P_2O_5, capable of producing a 37% P_2O_5 marketable concentrate. MCK has prepared a 20-year mine plan that shows total production of 48 Mt of ore averaging 23% P_2O_5 and producing 1.2 Mt/yr of 37% P_2O_5 concentrate. A chemical plant would also be constructed onsite and produce 400,000 t/yr of P_2O_5 contained in MAP or DAP. MCK was in the process of finding a buyer for the property, because it lacks sufficient capital to operate the facility (MCK Mining Corp., 1999).

China.—In February, Spur Ventures Inc. of Canada received final approval from the Chinese Government for the Yichang phosphate project. A feasibility study was expected to be completed in early 2000 and construction finished in 2002. According to Spur, proven reserves of phosphate rock are 90 Mt grading about 23% P_2O_5. An additional 360 Mt are classified as probable/possible. The ore would be upgraded into a marketable product containing 30% P_2O_5. Initial plans call for mining 2.5 Mt/yr of marketable phosphate rock to produce 480,000 t/yr of DAP and 620,000 t/yr of NPK fertilizers (Fertilizer Week, 1999b).

Guinea-Bissau.—Champion Resources Inc. of Canada signed a memorandum of understanding with Grasim Industries, Ltd. of India to supply phosphate rock from the Farim deposit in Guinea-Bissau. According to Champion, the deposit contains minable reserves of 105 Mt of 29.8 % P_2O_5. Projected output would be 750,000 t/yr of 29.8% P_2O_5 rock for 5 years, increasing to 1.5 Mt/yr for the next 20 years. The rock would be upgraded to 34% P_2O_5 marketable product at an onsite beneficiation facility. The deposit was in the final stages of development with construction of the processing plant scheduled to begin in the first half of 2000. The mine was expected to be commission in the third quarter of 2001. In the 5-year exclusive agreement, Grasim will take 300,000 t of rock in the first year and 750,000 t/yr for the rest of the term. Grasim, a subsidiary of Aditya Birla Group, will produce phosphoric acid at its new plant in Dahej, India (Fertilizer International, 2000).

India.—Demand for phosphate fertilizers has grown rapidly in India, which has limited resources of phosphate rock and has relied heavily on imports of both rock and phosphoric acid for fertilizer production. Several new WPPA/DAP plants were under construction that could greatly reduce the need for imports of finished fertilizers. By early 2001, 2.82 Mt/yr of DAP capacity was expected to be added in India (Phosphorus and Potassium, 1999c). The largest new fertilizer complex, Oswal, will initially have an annual production capacity of 1.5 Mt DAP and 0.42 Mt of NPK products. It will require 3 Mt/yr of imported phosphate rock to operate at full capacity. The company plans to use rock primarily from China and Syria (Phosphorus and Potassium, 1999b). The commissioning of the Oswal plant was delayed for six months until mid-2000 by extensive damage from a cyclone in October.

The actual amount of production realized in 2000 will depend upon how quickly plants can be operating at full capacity and on the fertilizer subsidy plan enacted by the Indian Government.

Jordan.—In August, the Jordanian Government completed privatization of the Aqaba Railways Corporation. A 25-year agreement to operate and expand the railway was signed between the Jordanian Government and an international consortium consisting of Wisconsin Central International Inc., Raytheon Infrastructure Inc., Mitsubishi Corp. (Japan), Consolidated Contractors Co. (Greece), and Jordan Phosphate Mines Co. (JPMC). The U.S. companies have a 51% share, while JPMC has 25% of the venture. Over the next 3 years, the group plans to invest $130 million to modernize the existing railroad between JPMC's Al-Abiad and Al-Hassa mines and the port of Aqaba. In addition, it will construct a new rail line between JPMC's largest phosphate rock mine, Eshidiya, and Aqaba (Phosphorus and Potassium, 1999a). In October, the U.S. Overseas Private Investment Corp. agreed to provide a loan of up to $55 million to the consortium (U.S. Overseas Private Investment Corp., 1999).

The 1998 joint venture between Norsk Hydro and JPMC, Hydo Agri Jordan Ltd., to produce phosphoric acid at Eshidiya and DAP and NPK fertilizers at Aqaba has been delayed after both companies posted losses in the first 6 months of 1999 (Fertilizer International, 1999).

Netherlands.—Hydro Agri Rotterdam B.V. closed its phosphoric acid plant in Vlaardingen in December because of

new laws concerning the disposal of phosphogypsum. The new regulation requires 90% of phosphogypsum to be treated or relocated. The company concluded that the cost of compliance would have been prohibitive to operate the plant profitably (Chemical Market Reporter, 1999).

Kemira Agro Oy of Finland announced it would close its Pernis fertilizer plant by July 2000 because of the new phosphogypsum regulations and market conditions. The facility had a production capacity of 220,000 t/yr P_2O_5 phosphoric acid and 240,000 t/yr DAP/MAP (Fertilizer Week, 1999a).

Outlook

The short-term outlook for the domestic phosphate industry is for the persistence of the market conditions of the past year. Domestic rock production will remain lower than the average of the past five years with the closure of several mines, which has reduced annual production capacity by more than 20%. Consumption of phosphate rock also will likely be lower than in 1999, owing to the closure of fertilizer production facilities, many of which are not expected to reopen until 2001, and lower export sales. Domestic demand for phosphate fertilizer was expected to increase slightly over last year, because total acreage planted was expected to be slightly higher for all crops. This will help to draw down stocks, but not increase production substantially.

Various industry analysts forecast world phosphate fertilizer production to increase at a rate of nearly 3% per year over the next decade. Likewise, phosphate rock demand also will increase at close to the same rate. The increasing world population and the need for adequate food supplies assures long-term growth for the phosphate rock industry. The areas with the highest growth rates, China and the Indian subcontinent, will continue to be the leading consumers of phosphates. U.S. companies have been the dominant suppliers in that region, but now face greater competition with the scheduled opening of several new DAP plants in the Indian subcontinent over the next two years. Total new annual capacity in India, Pakistan, and Bangladesh will be equivalent to the average annual shipments from the United States over the past several years. Imports will still be needed in the region to keep pace with growth in population and need for agricultural products; however, U.S. companies may not be able to recapture the lost market share. The new DAP plant in Australia will remove another export market for U.S. companies. These factors will make China an important market for U.S. companies. China has abundant phosphate rock resources and is a major exporter, but does not have sufficient fertilizer production capacity to meet demand. Several phosphate fertilizer production facilities are set to open within five years, but imports will still be necessary for some time. Chinese demand has been very inconsistent and affected by low grain prices, use of cheaper NPK compounds, an effort to limit imports, and other factors. Exports of phosphate fertilizers to China were expected to drop in 2000 after reaching a record high in 1999. Shipments of fertilizer to Latin American have grown, but will not fully replace lost sales to India. The full effect of greater foreign competition will not likely be felt until early 2001, but anticipation has already made an impact on the market.

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[1]Prior to 1996, published by the U.S. Bureau of Mines.

TABLE 1
SALIENT PHOSPHATE ROCK STATISTICS 1/

(Thousand metric tons and thousand dollars unless otherwise specified)

	1995	1996	1997	1998	1999
United States:					
Mine production (crude ore)	165,000	179,000	166,000	170,000	161,000
Marketable production:	43,500	45,400	45,900	44,200	40,600
P_2O_5 content	12,800	13,300	13,300	12,900	11,800
Value	$947,000	$1,060,000	$1,080,000	$1,130,000 r/	$1,240,000
Average, dollars per metric ton 2/	$21.75	$23.40	$24.40	$25.46	$30.56
Sold or used by producers: 3/	43,700	43,500	42,100	43,700	41,600
P_2O_5 content	13,000	12,900	12,200	12,700	12,100
Value 4/	$950,000	$1,020,000	$1,030,000	$1,130,000 r/	$1,310,000
Average, dollars per metric ton	$21.75	$23.40	$24.50	$25.87 r/	$31.49
Exports: 5/	2,760 6/	1,570	335	378	272
P_2O_5 content	875	NA	NA	NA	NA
Value	$78,300	$56,200	$11,700	$16,100	$11,400
Average, dollars per metric ton	$28.35	$35.82	$34.80	$42.70	$41.96
Imports for consumption e/ 7/	1,800	1,800	1,830	1,760	2,170
C.i.f. value e/	$91,800	$104,000	$91,800	$92,700	$123,000
Average, dollars per metric ton	$51.01	$57.91	$50.19	$52.66	$56.54
Consumption e/ 8/	42,700	43,700	43,600	45,000	43,500
Stocks, December 31, producers	5,710	6,390	7,910	7,920	6,920
World production, gross weight	131,000 r/	135,000	143,000 r/	144,000 r/	141,000 e/

e/ Estimated. r/ Revised. NA Not available.

1/ Data are rounded to no more than three significant digits, except average values per metric ton.

2/ Average value based on the sold or used values.

3/ Includes domestic sales and exports.

4/ Total value of all domestic and export sales.

5/ Source: Bureau of the Census for 1996-99.

6/ Exports reported to the U.S. Geological Survey by companies.

7/ Includes some estimated phosphate rock tonnage imported from Morocco not reported by the Bureau of the Census.

8/ Expressed as sold or used plus imports minus exports.

TABLE 2
ACTIVE PHOSPHATE ROCK MINES IN THE UNITED STATES IN 1999

Owner	Mine	County and State
Agrifos, L.L.C.	Nichols	Polk, FL
Agrium Inc.	Rasmussen Ridge	Caribou, ID
Cargill Fertilizer, Inc.	Hookers Prairie	Polk, FL
do.	South Fort Meade	do.
CF Industries, Inc.	South Pasture	Hardee, FL
FMC Corporation	Dry Valley	Caribou, ID
IMC-Agrico Co.	Four Corners	Hillsborough, FL
do.	Fort Green	Polk, FL
do.	Hopewell	Hillsborough, FL
do.	Kingsford	Polk/Hillsborough, FL
do.	Noralyn	Polk, FL
do.	Payne Creek	do.
J.R. Simplot Co.	Smoky Canyon	Caribou, ID
Nu-Gulf Industries, Inc.	Wingate Creek	Manatee, FL
P4 Production, L.L.C.	Enoch Valley	Caribou, ID
PCS Phosphate Co., Inc.	Swift Creek	Hamilton, FL
do.	Aurora	Beaufort, NC
SF Phosphates, Ltd. Co.	Little Brush Creek	Uintah, UT

TABLE 3
PRODUCTION OF PHOSPHATE ROCK IN THE UNITED STATES, BY REGION 1/

(Thousand metric tons and thousand dollars)

Period/region	Mine production (crude ore)		Marketable production			
			Beneficiated			Ending stocks,
	Rock	P_2O_5 content	Rock	P_2O_5 content	Value 2/	rock
1998	170,000	13,300	44,200	12,900	1,130,000 r/	7,920
1999:						
January-June:						
Florida and North Carolina	75,200	6,790	17,400	5,110	628,000	5,320
Idaho and Utah	3,740	826	2,850	743	77,600	1,510
Total	78,900	7,610	20,300	5,860	706,000	6,840
July-December:						
Florida and North Carolina	75,200	7,100	17,300	5,060	461,000	5,200
Idaho and Utah	6,460	1,150	3,010	852	72,700	1,720
Total	81,600	8,250	20,300	5,910	533,000	6,920
Grand total	161,000	15,900	40,600	11,800	1,240,000	XX

r/ Revised. XX Not applicable.
1/ Data are rounded to no more than three significant digits; may not add to totals shown.
2/ Average value based on the sold or used values.

TABLE 4
PHOSPHATE ROCK SOLD OR USED BY PRODUCERS
IN THE UNITED STATES, BY GRADE AND REGION 1/

(Thousand metric tons and thousand dollars)

Period and grade (percent BPL content 2/)	Rock	P_2O_5 content	Value 3/
1998	43,700	12,700	$1,130,000 r/
1999:			
January-June:			
60 to less than 66	16,600	4,910	633,000
Other 4/	4,760	1,280	137,000
Total	21,400	6,200	770,000
July-December:			
60 to less than 66	17,800	5,220	468,000
Other 4/	2,430	676	71,400
Total	20,200	5,890	540,000
Grand total	41,600	12,100	1,310,000
Florida and North Carolina	35,900	10,500	1,100,000
Idaho and Utah	5,540	1,530	142,000

r/ Revised.
1/ Data are rounded to no more than three significant digits; may not add to totals shown.
2/ 1.0% BPL (bone phosphate of lime or tricalcium phosphate)=0.458% P_2O_5.
3/ F.o.b. mine.
4/ Includes less than 60% and greater than 66% BPL content.

TABLE 5
VALUE OF U.S. PHOSPHATE ROCK, BY GRADE

(Dollars per metric ton, f.o.b. mine)

Grade	1998			1999		
(percent BPL content 1/)	Domestic	Export	Average	Domestic	Export	Average
70 to less than 72	19.68	--	19.68	W	W	W
66 to less than 70	28.71	W	29.51	31.27	W	31.36
60 to less than 66	25.00	W	25.03	30.08	W	32.03
Weighted average 2/	25.46	42.70	25.87 r/	30.56	41.96	31.49

r/ Revised. W Withheld to avoid disclosing company proprietary data. -- Zero.
1/ 1.0% BPL (bone phosphate of lime or tricalcium phosphate)=0.458% P_2O_5.
2/ Includes less than 60%, and greater than 72%, in addition to the grades listed.

TABLE 6
U.S. EXPORTS OF GROUND AND
UNGROUND PHOSPHATE ROCK 1/

(Thousand metric tons)

Country	1998	1999
Australia	2	1
Canada	38	37
Japan	21	2
Korea, Republic of	2	--
Netherlands	270	160
Other	45	72
Total	378	272

-- Zero.
1/ Data are rounded to no more than three significant digits; may not add to totals shown.

Source: Bureau of the Census.

TABLE 7
U.S. EXPORTS OF SUPERPHOSPHATES
(CONCENTRATED)

(Thousand metric tons)

Country	1998	1999
Argentina	2	8
Australia	217	205
Bangladesh	95	123
Brazil	121	82
Canada	12	10
Chile	89	62
Japan	30	52
Peru	17	8
Uruguay	8	5
Other	31	79
Total	622	634

Source: Bureau of the Census.

TABLE 8
U.S. EXPORTS OF DIAMMONIUM PHOSPHATE 1/

(Thousand metric tons)

Country	1998	1999
Argentina	226	167
Australia	626	429
Brazil	73	16
Canada	113	102
China	5,180	5,220
Ecuador	47	62
India	1,270	2,340
Japan	352	334
Kenya	39	114
Mexico	251	256
Pakistan	643	355
Thailand	302	239
Other	694	787
Total	9,870	10,500

1/ Data are rounded to no more than three significant digits; may not add to totals shown.

Source: Bureau of the Census.

TABLE 9
U.S. EXPORTS OF
MONOAMMONIUM PHOSPHATE 1/

(Thousand metric tons)

Country	1998	1999
Australia	351	432
Brazil	354	306
Canada	502	514
Chile	44	26
Colombia	117	105
Guatemala	16	34
Japan	130	123
Mexico	35	77
Thailand	59	25
Other	71	147
Total	1,680	1,790

1/ Data are rounded to no more than three significant digits; may not add to totals shown.

Source: Bureau of the Census.

TABLE 10
U.S. EXPORTS OF PHOSPHORIC ACID 1/

(Thousand metric tons)

Country	1998	1999
Australia	106	118
Canada	60	25
India	230	189
Venezuela	21	4
Other	116	63
Total	533	399

1/ Excludes superphosphoric acid tonnage.

Source: Bureau of the Census as adjusted by the U.S. Geological Survey.

TABLE 11
U.S. EXPORTS OF ELEMENTAL PHOSPHORUS 1/

	1998		1999	
Country	Quantity (metric tons)	Value 2/ (thousands)	Quantity (metric tons)	Value 2/ (thousands)
Brazil	174	$297	145	$218
Canada	1,380	2,640	841	1,460
Japan	2,820	4,970	2,100	3,710
Korea, Republic of	98	202	154	292
Mexico	3,370	7,230	1,970	4,340
Netherlands	6	12	--	--
Other	182	402	531	1,060
Total	8,020	15,700	5,740	11,100

-- Zero.
1/ Data are rounded to no more than three significant digits; may not add to totals shown.
2/ F.a.s. values.

Source: Bureau of the Census.

TABLE 12
U.S. IMPORTS FOR CONSUMPTION OF PHOSPHATE ROCK AND PHOSPHATIC MATERIALS 1/

(Thousand metric tons and thousand dollars)

Phosphatic materials	1998		1999	
	Quantity	Value 2/	Quantity	Value 2/
Natural calcium phosphates, unground 3/	228	7,950	92	4,150
Natural calcium phosphates, ground 3/	580	34,500	653	38,800
Total calcium phosphates 4/	1,760	92,700	2,170	123,000
Dicalcium phosphate	7	8,670	7	7,720
Elemental phosphorus	2	4,160	2	4,190
Normal superphosphate	(5/)	3	(5/)	6
Triple superphosphate	76	12,900	64	10,400
Diammonium phosphate	44	11,100	36	8,360
Fertilizer containing nitrates and phosphates	153	12,400	114	7,810
Phosphoric acid	2	778	1	251

1/ Data are rounded to no more than three significant digits.
2/ Declared c.i.f values.
3/ Some phosphate rock tonnages and values were suppressed by the Bureau of the Census.
4/ Includes an estimate for data suppressed by Bureau of the Census.
5/ Less than 1/2 unit.

Source: Bureau of the Census.

TABLE 13
PHOSPHATE ROCK ANNUAL WORLD PRODUCTION CAPACITY, DECEMBER 31, 1999 1/

(Thousand metric tons)

Region/country	Capacity
United States	43,300
Africa	52,500
Asia	28,000
Europe and the former U.S.S.R.	13,800
Middle East	14,700
Latin America	6,430
Oceania	1,400
Total	160,000

1/ Data are rounded to no more than three significant digits; may not add to totals shown.

Sources: International Fertilizer Industry Association and the U.S. Geological Survey.

TABLE 14
PHOSPHATE ROCK, BASIC SLAG, AND GUANO: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Thousand metric tons)

Commodity and country	Gross weight					P_2O_5 content				
	1995	1996	1997	1998	1999 e/	1995	1996	1997	1998	1999 e/
Phosphate rock:										
Albania e/	2	2	1	1	1	(3/)	(3/)	(3/)	(3/)	(3/)
Algeria	1,596 r/	1,051	1,063 r/	1,115 r/	1,100	500 r/	320	330 r/ e/	358 r/ e/	350
Australia	5	1	1 e/	1 e/	2	1	(3/)	(3/) e/	(3/) e/	(3/)
Brazil	3,888	3,823	4,270	4,421 r/	4,100	1,364	1,353	1,500	1,560 r/	1,450
Chile	12	17	13	15 r/	15	3	5	3	4 r/	4
China e/	19,300	21,000	24,500	25,000	25,100	5,790	6,300	7,530	7,500	7,530
Christmas Island e/	430 4/	600	600	600	600	145 4/	198	198	198	198
Colombia	50 e/	40	45	50 e/	50	11 e/	8	9	11 e/	11
Egypt 5/	765	808	900	1,058 r/	1,050	207	222	240	320 r/	320
Finland	671	667	690 r/	716 r/	700	244	246	254 r/	260 r/	260
India	1,332	1,432	1,043 r/	1,730 r/	1,750	360	387	282 r/	467 r/	473
Indonesia	8 e/	8 e/	1 r/	1 r/	2	2 e/	2 e/	(3/) r/	(3/) r/	(3/)
Iraq e/ 5/	1,000	1,000	1,000	1,000	1,000	300	300	300	300	300
Israel 5/	4,063	3,839	4,047	4,050 r/	4,100	1,264	1,201	1,250 r/	1,288 r/	1,300
Jordan	4,984	5,355	5,896	5,967 r/	6,000	1,655	1,765	1,940 r/	1,968 r/	1,980
Kazakhstan e/	1,700	1,700	1,000 r/	100 r/	--	500	500	290 r/	29 r/	--
Korea, North e/	520	520	520	450	350	164	164	164	142	105
Mexico	622	682	714	756	1,000	180	205	214	227 r/	300
Morocco 6/	20,684 r/	20,855	23,084 r/	23,587 r/	24,000	6,399 r/	6,552 r/	7,848 r/	7,850 r/	7,850
Nauru	496	510	491 r/	487 r/	600	190	194	187 r/	185 r/	230
Pakistan e/	10 4/	10	11 r/ 4/	11 r/	12	2	2	2 r/	2 r/	2
Peru	30	103	104 r/ e/	104 e/	104	9	32 r/	32 r/ e/	37 e/	37
Philippines e/	32 r/ 4/	30 r/	30 r/	30 r/	30	11 r/	10 r/	10 r/	10 r/	10
Russia e/	9,000	8,500	9,900	10,000 r/	11,100	3,100	2,900	3,300	3,300	3,700
Senegal e/	1,500	1,340	1,565 r/	1,478 r/	1,800	545	478	575 r/	540 r/	650
South Africa	2,822	2,655	2,732	2,739 r/	2,900	1,101	1,036	1,066	1,068 r/	1,100
Sri Lanka e/	30 4/	34	30 4/	30	30	10	12	10	10	10
Syria	1,551	2,189	2,392	2,496 r/	2,100	477	670	730 r/	765 r/	635
Tanzania	21	28 r/	3	2 r/	2	7	9 r/	1	1	1
Thailand	9	4	4	3 r/	4	3	1	1	1	1
Togo	2,570	2,731	2,631 r/	2,250 r/	1,700	930 r/	980 r/	955 r/	812 r/	610
Tunisia	7,241	7,167	6,941 r/	7,901 r/	8,000	2,182	2,150	2,140 r/	2,370 r/	2,400
United States	43,500	45,400	45,900	44,200	40,600 4/	12,800	13,300	13,300	12,900 r/	11,800 4/
Venezuela	86 r/	148	291 r/	322 r/	350	23 r/	40	79 r/	87 r/	95
Vietnam e/	600	475	834	860	850	181	143	250	258	255
Zimbabwe, concentrate e/	154 4/	123 4/	94 r/	91 r/	90	45	39	30 r/	29 r/	29
Total	131,000 r/	135,000	143,000 r/	144,000 r/	141,000	40,700 r/	41,700	45,000 r/	44,800 r/	44,000

See footnotes at end of table.

TABLE 14--Continued
PHOSPHATE ROCK, BASIC SLAG, AND GUANO: WORLD PRODUCTION, BY COUNTRY 1/ 2/

(Thousand metric tons)

Commodity and country	Gross weight					P_2O_5 content				
	1995	1996	1997	1998	1999 e/	1995	1996	1997	1998	1999 e/
Basic (Thomas converter) slag: e/										
Egypt	8	8	8	8	8	2	2	2	2	2
France	140	77	44	45	50	18	14	8	8	8
Germany	125	125	125	125	150	19	19	19	19	20
Luxembourg	500	500	500	500	475	75	75	75	75	70
Total	773	710	677	678	683	114	110	104	104	100
Guano: Philippines e/	5	5	5	5	5	2	2	2	2	2

e/ Estimated. r/ Revised. -- Zero.

1/ Table includes data available through May 11, 2000. Data for major phosphate rock-producing countries derived in part from the International Fertilizer Industry Association; other figures are from official country sources where available.

2/ World totals, U.S. data, and estimated data are rounded to no more than three significant digits; may not add to totals shown.

3/ Less than 1/2 unit.

4/ Reported figure.

5/ Beneficiated.

6/ Includes production from Western Sahara.