PHOSPHATE ROCK

By Stephen M. Jasinski

Domestic survey data and tables were prepared by Christopher H. Lindsay, statistical assistant, and the world production table was prepared by Glenn J. Wallace, international data coordinator.

Phosphorus is an essential element for plant and animal nutrition. Phosphorus is consumed primarily as a principal component of nitrogen-phosphorus-potassium (NPK) fertilizers that are used to enhance the growth of 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 and phosphate fertilizers. Domestic production decreased for the second consecutive year owing to the closure of two mines and lower production rates at several others. Mines in Florida and North Carolina accounted for 86% of domestic marketable production, with the remainder produced in Idaho and Utah. More than 90% of the phosphate rock mined was used to produce chemical fertilizers and animal feed supplements; the remainder was used to produce elemental phosphorus (P_4) and other industrial phosphates. Two companies in Idaho produced P_4 for downstream industrial compounds.

Domestic consumption and sales of marketable phosphate rock decreased by 10% from that of 1999. Manufacturers of phosphate fertilizers continued to be affected by weak export sales, primarily to China and India, which have been the major destinations for U.S. fertilizer exports for the past decade. In response to market conditions, several phosphoric acid plants were closed temporarily during the year, resulting in a drop in consumption of phosphate rock. Imports of phosphate rock were down by 11% after reaching a record high in 1999. The U.S. Census Bureau reported that wet process phosphoric acid (WPPA) production was 11.4 million metric tons (Mt) as available phosphorus pentoxide (P_2O_5) compared with 12.2 Mt in 1999 (U.S. Census Bureau, 2001). U.S. producers accounted for nearly 40% of world trade in converted phosphate products (Demetriou, 2001, p. 7). The major fertilizer products were diammonium phosphate (DAP), monoammonium phosphate (MAP), triple superphosphate (TSP), and WPPA.

Legislation and Government Programs

The U.S. Drug Enforcement Administration (DEA) proposed classifying red phosphorus, yellow phosphorus, and hypophosphorous acid as controlled substances or List I chemicals because they have been identified as being important chemicals for the illicit manufacturing of methamphetamine. Handlers of List I chemicals are subject to the Controlled Substances Act regulatory controls including registration, recordkeeping, reporting, and import/export requirements. The DEA determined that these controls are necessary to prevent the diversion of these chemicals to drug laboratories. The agency did not propose a threshold limit for reporting because there are few legitimate uses for the compounds, and only small quantities of the substances are required to manufacture methamphetamine. Industrial uses of red phosphorus include pyrotechnics, matches, incendiary shells, tracer bullets, and other phosphorus compounds. Red phosphorus and

Phosphate Rock in the 20th Century

In 1900, the United States was the largest producer of phosphate rock in the world, accounting for 48% of world production of 3.15 million metric tons. By that time, Florida had become the dominant producing State surpassing South Carolina, where phosphate rock was first discovered and mined in the United States in 1867. At this time, mining had begun shifting from river dredging to exploitation of hard rock and land-pebble deposits. Mining was accomplished by horse- and mule-drawn scrapers, pick and shovel, and in a few instances, steam shovels. By 1904, manual methods had been replaced by electric shovels to remove the overburden, and hydraulic pumps were used to move matrix to the washer plant. The implementation of the dragline in 1920 greatly improved efficiency by reducing labor and increasing the quantity of ore mined. In 1928, the flotation process was patented enabling companies to recover up to 95% of the phosphate that was previously discarded. Phosphate rock mining began in the Western United States in 1907 and in North Carolina in 1966. Phosphate rock production capacity doubled from 1960 to 1970 in response to increased demand for fertilizer and the shift to multinutrient, high-analysis fertilizers. Throughout the 20th century, fertilizer production was the major use of phosphate rock. Elemental phosphorus production and industrial applications never achieved more than 10% of total domestic usage.

In 2000, the United States remained the largest producer of phosphate rock in the world, accounting for nearly 29% of total world production of 133 million tons, and was the largest consumer of phosphate rock and largest exporter of phosphate fertilizers. Florida remained the largest producing State, followed by North Carolina, Idaho, and Utah. The United States was a major world supplier of phosphate rock until the early 1990s when producers shifted emphasis to exporting higher value fertilizer materials.

hypophosphorous acid are derivatives of P_4 and the DEA estimates that only 2% of the P_4 produced domestically is converted into a form that will be subject to the regulation (U.S. Department of Justice, 2000).

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 companies responded to the canvass.

Phosphate rock production decreased for the second consecutive year, reaching its lowest point since 1993 (tables 1, 3). The phosphate industry was affected by a significant drop in export sales of DAP, the largest volume fertilizer product, and of phosphoric acid. Marketable output from Florida and North Carolina was down by 4%, owing to the closure of one mine in late 1999 and another in August 2000. Overall, production rates at the other mines were nearly the same as in 1999; consumption, however, dropped by 10%, and therefore stocks increased substantially. In Idaho and Utah, production declined by 10% owing to the combined effects of a temporary closure of one mine, stock depletion, and seasonal demand fluctuation. U.S. mine production was at 86% of rated annual capacity (table 13).

Southern States.—In Florida, phosphate rock was mined and processed by five companies: Agrifos, L.L.C.; Cargill Fertilizer, Inc.; CF Industries, Inc.; IMC Phosphates MP, Inc.; and PCS Phosphate Co., Inc. Their mines and plants were located in Hamilton, Hardee, Hillsborough, and Polk Counties (table 2). The Nu-Gulf Industries, Inc., Wingate Creek Mine in Manatee County was closed for the entire year. 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.

In December, Farmland-Hydro L.P. submitted a permit application to open a 6,114-hectare (ha) phosphate rock mine in Hardee County. According to the company, planned production will be 2.7 million metric tons per year (Mt/yr) for 30 years. A beneficiation plant will be built onsite, and the phosphate rock will be sent by rail to the Fort Meade WPPA facility in Polk County. Under Florida's ecosystem management team permitting process, the consolidated development application (CDA) is filed simultaneously with all appropriate Federal, State, and local agencies after the company conducts meetings with all interested parties. The application requires the demonstration of a net benefit to the environment in the form of the reclamation plan that restores a greater area of land than is disturbed. The firm anticipates receiving the permit by the end of 2001 (Green Markets, 2001b).

In May, IMC Phosphates filed a CDA for its proposed Ona Mine in Hardee County. The mine would encompass 8,335 ha, of which 24% of the area would not be disturbed. Total minable reserves are estimated to be 150 Mt. According to IMC, during the first 8 years of operation, it plans to mine 2.72 Mt/yr, and for the balance of the 24-year life of the facility, it will mine 5.45 Mt/yr. For each hectare of wetlands disturbed, it will create an average of 1.6 ha. Approval was anticipated by the end of 2001. IMC expected to submit a CDA for the proposed Pine Level Mine in DeSoto County in 2001 or 2002 (Green Markets, 2000d).

Agrifos closed its Nichols Mine in August in response to economic conditions, according to the company. Prior to the closure, production was limited because of excess water in the mine. Nichols was one of the smallest phosphate rock mines in Florida, with a production capacity of 1.1 Mt/yr. No decision had been made on whether the mine and its reserves would be sold. The Agrifos Fertilizer, LLC, plant in Pasadena, TX, would not be affected by the closure; it would rely exclusively on imported rock. Duke Energy Corp. acquired a financial interest in Agrifos, and Duke's wholly owned subsidiary, Duke Energy Merchants, L.L.C., will assume product sales and raw material purchasing responsibilities for the Pasadena facility (Green Markets, 2000e).

Mulberry Corp., the parent company of Mulberry Phosphates, Inc., Piney Point Phosphates, Inc., and Nu-Gulf Industries, ceased operations at all facilities in 1999, all of which remained closed in 2000. In December, the Florida Department of Environmental Protection (FDEP) sought to suspend the company's operating permits for its two processed phosphate plants because of failure to comply with orders to correct groundwater contamination (Green Markets, 2000b). In early 2001, Mulberry filed for chapter 11 bankruptcy protection and abandoned its facilities. The FDEP was then forced to maintain the Mulberry and Piney Point plants after Mulberry could not pay its electric bill. Although the plants had been closed for more than a year, electric pumps circulated water continuously through the phosphogypsum stacks. If the power were turned off, the acidic water could overflow into nearby waterways (Green Markets, 2001c).

Six concentrated phosphate plants were located along the Gulf of Mexico. IMC Phosphates operated a phosphoric acid plant at Uncle Sam, LA, using phosphate rock from the firm's mines in Florida and a DAP/MAP granulation facility at Faustina, LA. Both plants were closed for several months between January and October and then closed indefinitely in November owing to market conditions. The company's Taft, LA, DAP granulation facility and the Faustina phosphoric acid plant were closed for the entire year (IMC Global Inc., 2000, p. 3). 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 plant in Pasadena, TX, used both phosphate from the company's Nichols Mine in Florida and imports from Morocco.

Idaho and Utah.—In Idaho, four companies conducted open pit mining in Caribou County (table 2). Astaris L.L.C. operated the Dry Valley Mine on Federal and private leases, to provide feedstock for P_4 production at its Pocatello plant. Monsanto Co. operated the Enoch Valley Mine, which supplied its P_4 plant in Soda Springs. Agrium Inc. produced phosphate rock from the Rasmussen Ridge Mine to feed its Conda WPPA and DAP plants. J.R. Simplot Co. operated the Smoky Canyon Mine,

which supplied its WPPA plant in Pocatello, by a 138-kilometer (km) slurry pipeline.

In October, Agrium was forced to close its phosphoric acid plant after a wall of a digester tank collapsed, which resulted in the spill of phosphoric acid and rock slurry. The plant was reopened in December at 80% capacity. The tank was scheduled for replacement in 2001 as part of the Agrium-Astaris joint-venture project to produce purified phosphoric acid, which will increase annual WPPA production capacity at the plant to 375,000 metric tons per year (t/yr) from 280,000 t/yr P_2O_5 (Agrium Inc., 2001, p. 23).

Astaris began implementation of an emission reduction program and site modifications to its Pocatello facility that were mandated by the U.S. Environmental Protection Agency in 1999 for violations of the clean air and water regulations (Green Markets, 2000c). In September, Astaris announced plans to reduce P_4 production by closing two of the four electric furnaces at its Pocatello, ID, plant in 2002. The company cited market conditions and the construction of a new purified phosphoric acid plant, which would be operated by Agrium and Astaris, as reasons for the closure (Green Markets, 2000a). In April 2001, Astaris accelerated its closure plan and reduced operations to one furnace in response to the rising cost of electricity (Green Markets, 2001a).

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

Universal Chemical Corp. continued in its efforts to obtain financing to open a phosphate rock conversion facility in eastern Utah. The company plans to use phosphate rock from the Ashley Valley Phosphate Co. deposit that is located near Vernal. Universal plans to process the phosphate ore with a method that was developed in Europe but never used in North America. Unlike conventional phosphoric acid production, which uses sulfuric acid to digest the rock, the rock would be treated with a weak hydrochloric acid solution onsite, which readily separates the silica, clay, and other impurities from the phosphate. The resulting phosphate-calcium solution would be transported by pipeline 71 km to the plant and the remaining inert material would be used for mine reclamation. The phosphate solution would be used to produce dicalcium and monocalcium phosphate for animal feed supplements and phosphoric acid. The byproduct calcium chloride could be reacted with sulfuric acid to manufacture food-grade gypsum. The State of Utah received a Federal grant of $870,000 to study the extension of a railroad line from the site of the proposed plant in Bonanza to connect with an existing rail line at Rifle, CO. The State has been working for more than 2 years on an economic development proposal that includes the 1,370-ha phosphate mine, a phosphate processing facility, a gypsum wallboard plant, a fertilizer plant, administration offices, and the 82-km short-line railroad. As of December 31, the company was in the process of obtaining financing for the project (Green Markets, 2000f).

Consumption

In 2000, apparent consumption was at its lowest level since 1993, and reported phosphate rock sold or used was at the lowest point since 1971 (table 4). Both decreased by 10% from that of 1999 owing to a drop in phosphoric acid production (U.S. Census Bureau, 2001). The weak market conditions that began in 1999 continued throughout 2000, with domestic producers exporting less to China and India because of increased competition, lower demand, new plants opening in the region, and high world inventories. Several fertilizer manufacturers in the Southern States temporarily closed production facilities in response to the significant decrease in DAP export sales. The major fertilizer producers in the South rely on exports for the bulk of their business, because the domestic market is mature and normally fluctuates very little from year to year. Domestic consumption of P_2O_5 contained in fertilizer increased slightly for the crop year ending June 30 (Terry and Kirby, 2001, p. 6).

Phosphate rock used in the Western United States fell slightly because of the temporary closure of the Agrium plant, which resulted in a concurrent drop in rock production and seasonal fertilizer demand fluctuations. Western fertilizer manufacturers only sold their products domestically and were not affected by the world market situation. The only two P_4 plants in the Western Hemisphere are located in Idaho. Approximately 65% of P_4 was consumed to manufacture thermal phosphoric acid, which was used directly in detergents, food additives, water- and metal-treatment chemicals, and soft drinks, and as a raw material to make calcium, potassium, and sodium phosphates. The other 35% of P_4 was used directly to manufacture phosphorus trichloride, pentasulfide, and other compounds that were used in herbicides, insecticides, flame-retardants, lubrication greases, and plasticizers. Production of thermal phosphoric acid was 283,000 metric tons (t) of P_2O_5 compared with 259,000 t in 1999 (U.S. Census Bureau, 2001). Exports of P_4 fell to 3,440 t from 5,740 t in 1999 (table 11).

Purified wet-process phosphoric acid (PWA), which is less costly to produce than thermal acid, had attained a greater market share than thermal acid as a raw material for industrial phosphorus derivatives (Hume and others, 2000). PWA can be used to produce most phosphorus compounds except phosphorus pentasulfide and phosphorus trichloride, which is used to make herbicides, pesticides, and flame-retardants. U.S. P_4 production capacity was expected to drop to about 150,000 t/yr in 2001 from 236,000 t/yr to with the closure of three of the four furnaces at the Astaris plant in Pocatello, ID. Astaris will then begin producing PWA at a new 80,000 t/yr facility it will operate with Agrium at Soda Springs, ID (Green Markets, 2000a).

Stocks

U.S. stocks of phosphate rock ended the year 18% higher than in 1999 owing to the temporary closure of several phosphoric acid plants in Florida and Louisiana. Mine production continued on a regular schedule in anticipation of building stock

when the plants eventually reopen. By region, stocks increased by 27% in Florida and North Carolina and dropped by 10% in Idaho and Utah (table 3).

Transportation

In Florida, beneficiated phosphate rock was moved by rail and truck to phosphoric acid plants within the State. Phosphate rock, phosphate acid, fertilizers, and animal feed supplements were sent by rail or truck to the port of Tampa and then were shipped for domestic use or export. More than 22 Mt/yr of phosphate-related materials move through the port of Tampa, representing nearly 50% of total tonnage handled at the port (Tampa Port Authority, 2000, Bulk cargo, accessed April 3, 2001, at URL http://www.tampaport.com/bulkcargo.htm).

Phosphate fertilizers produced by companies along the Gulf of Mexico were transported primarily by barge on the Mississippi River and its tributaries, by rail, and by truck for domestic consumption. Exported products were shipped directly from major ports along the Gulf of Mexico. PCS Phosphates operated a port facility at Morehead City, NC, for export and import. Phosphates produced at its Florida facilities were sent by rail to Morehead City. In the West, phosphate ore was sent from the mine via truck, rail, and slurry pipeline to production facilities.

Prices

The average price for domestic phosphate rock decreased by 21% in 2000 (table 5).

Foreign Trade

Imports of phosphate rock were estimated to be 1.93 Mt, an 11% decrease from that of 1999. Reported imports from the U.S. Census Bureau were 665,000 t because some data were suppressed (table 12). More than 99% of all imported phosphate rock was from Morocco and primarily used by three companies: Agrifos, Mississippi Phosphates, and PCS Nitrogen.

Phosphate rock exports increased by 10% to 299,000 t (table 6). Domestic exports of DAP, the major phosphate fertilizer product, dropped by 27% compared with 1999 because of reduced purchases by China and India. Exports of DAP to India were down by 85% from the previous year owing to large inventories, government subsidy programs that encourage purchasing from Indian companies, and lower demand. The Oswal Chemicals and Fertilizers Ltd. 1.5-Mt/yr DAP plant began production early in the year; however, it never achieved full operating capacity because of phosphate rock supply problems (Fertilizer International, 2000c). The IndoGulf Corp. 400,000-t/yr DAP plant was commissioned in September and, unlike Owsal, the facility used imported WPPA (Fertilizer International, 2000b). Neither plant had a significant impact on trade. China imported 11% less DAP from the United States because of lower demand, high inventory, and increased internal production. Phosphoric acid and concentrated superphosphate exports also decreased, while MAP exports increased by 28% (tables 7-10). Overall, the United States accounted for 40% of total world trade in processed phosphates. By product, DAP accounted for 61% of the total world trade, followed by MAP with 25% and TSP with 14% (Demetriou, 2001, p. 7).

World Review

World production was estimated to have decreased to 133 Mt from 137 Mt in 1999 (table 14). The United States, Morocco, China, and Russia accounted for 65% of total production, by order of output. In addition to lower production, worldwide shipments of phosphate rock decreased for both export and internal consumption, while stocks increased (Demetriou, 2001, p. 6). The closure of two phosphoric acid plants in the Netherlands and the opening of a phosphate rock mine in Canada reduced trade in phosphate rock in Europe and North America. In Asia, such traditional suppliers as Jordan, Morocco, and Togo faced increased competition from China. World consumption of phosphate rock, which closely mirrors production, was estimated to have fallen slightly. Consumption of P_2O_5 for fertilizer increased slightly (Prud'homme and Soh, 2000). New fertilizer plants in Australia and India, which began operation in late 1999, had difficulties achieving full operating capacity but apparently corrected problems by the end of the year.

Australia.—WMC Fertilizers Pty. Ltd. started production at its Queensland Mine, which supplied its nearby fertilizer plant complex. The mine has a rated capacity of 2.2 Mt/yr and demonstrated reserves of 100 Mt. The mine was expected to be operating at full capacity in 2001, after two major problems were corrected with the fertilizer plant. Early in the year, the phosphoric acid plant experienced problems with the agitator blades in two reactors, and then the entire ammonia plant was closed for several extended periods for retooling. By October, the facility was operating at 60% of annual production capacity (WMC Ltd., 2001).

China. — Spur Ventures, Inc., released the results of a feasibility study of the Yichang phosphate project in central China. The project consists of five phosphate rock deposits containing 579 Mt of reserves averaging 21.2% P_2O_5. The company proposes to vertically integrate mining and fertilizer production to manufacture high-analysis fertilizers. Anticipated mine production will be 1.25 Mt/yr of phosphate concentrate. A 126-km long, 22-centimeter diameter pipeline was proposed to be built to transport the concentrate to the chemical plant near the Yangtze River. The fertilizer plant would produce either NPK compounds or DAP. Initial capacity would be 480,000 t/yr DAP and 529,000 t/yr NPK. Total estimated cost of the project was $371 million (He, 2000).

The Phosphate Chemicals Export Association, Inc. (PhosChem) signed a 2-year extension to its existing DAP supply contract with China National Chemicals Import and Export Corp. (Sinochem). The new pact would run through December 31, 2002, and under the terms of the agreement, Sinochem would purchase unspecified monthly shipments with an option to purchase additional tonnage (Phosphate Chemical

Export Association, Inc., 2000).

Cargill was planning to assist the Yunnan Phosphate Fertilizer Factory in upgrading its phosphoric acid plant and adding a DAP granulation facility with a capacity of 600,000 t/yr. Each company would contribute $15 million to the project. Yunnan Province had about 20% of the country's phosphate rock reserves, but only about 10% to 15% was considered suitable for WPPA production (Fertilizer Markets, 2000a).

The U.S. Trade Representative negotiated a United States-China fertilizer trade agreement in April that would become effective with China's accession into the World Trade Organization (WTO). The agreement established a tariff rate quota for certain fertilizers and expanded the opportunities for direct sales and distribution by foreign companies in China. The agreement set a quantity subject to a quota tariff of 4% and any tonnage above the amount would be subject to a 50% tariff. The DAP quota would start with a tonnage of 5.5 Mt and increase gradually to 6.9 Mt over 6 years. The Chinese Government would have to set the quota by January 1 of each year and could not revise it during the year.

The other provision, which would take effect after 5 years, would allow free trade in fertilizers within China by foreign-owned companies. Prior to the agreement, companies were required to enter into joint-venture agreements with Chinese companies and could not be the majority partner (The Fertilizer Institute, 2000).

Guinea-Bissau.—The Federal Government formalized mining leases on the Champion Resources, Inc., Farim phosphate rock deposit. The leases would be valid for 25 years and automatically renewable for another 25 years. Champion released the results of the final mine plan study. The report indicated recoverable reserves of 166.2 Mt of phosphate ore grading 29.8% P_2O_5, a 58% increase in tonnage from initial tests conducted in 1999. The initial 15-year mine plan anticipated a production rate of 2.47 Mt/yr of 31% P_2O_5 concentrate, which would be upgraded to 32% to 34% P_2O_5. Champion must still finalize financing agreements for the project (Fertilizer International, 2000a).

Jordan.—Norsk Hydro decided against entering into a joint venture with Jordan Phosphate Mines Co. (JPMC) to build a 440,000-t/yr phosphoric acid plant near the JPMC Eshidiya Mine and two 627,000-t/yr DAP/NPK plants at Aqaba. Hydro cited that it had given higher priory to other projects; the rise in worldwide P_2O_5 capacity, low DAP prices, and Indian subsidy programs that limit imports, however, were believed to have influenced the decision. The project was to be part of the JPMC long-term plan to gradually increase mine production at Eshidiya while decreasing production at its other two mines. Financing for the construction of a rail line from Eshidiya to Aqaba was being reevaluated because it would have been primarily for this project. JPMC had not announced whether another partner would be sought or if it would attempt to finance the project independently (Fertilizer Markets, 2000b).

Saudi Arabia.—Saudi Arabian Mining Co. approved development of the Al Jalamid phosphate project in the northwestern part of the country. The project would consist of a mine and DAP plant, focusing on the export market. The Al Jalamid deposit had proven reserves of 216 Mt, with an average grade of 32.5% P_2O_5. Based on an average mine output of 4.3 Mt/yr, the deposit could be mined for more than 50 years. The proposed DAP plant would have an annual capacity of 2 to 4 Mt/yr, although initial capacity would be around 1 Mt/yr and would be adjusted to market conditions. The mine was located about 1,100 km from the port of Al Jubail and no transportation links existed between the mine and port. A rail line had been considered and other options were being evaluated. A five-part detailed mining study started in midyear and was expected to be completed in mid-2001. Construction would not begin until the third quarter of 2001 at the earliest (Fertilizer International, 2001).

Outlook

The short-term outlook for the domestic phosphate industry will depend upon how quickly exports of processed phosphates, primarily DAP, can return to the levels achieved prior to 2000. Phosphate rock production and consumption in the Florida-North Carolina region will likely be lower in 2001 because of the high inventories accumulated in 1999 and 2000 and the indefinite closure of two mines and several fertilizer plants during the same period. Output and demand in Idaho and Utah is expected to remain steady. The opening of a new PWA plant will offset the reduction in P_4 production capacity.

World production of phosphate rock, which has been on a downward trend for the past 2 years owing to reduced demand by fertilizer manufacturers, will begin to increase at about the same rate as fertilizer consumption. World demand for phosphate fertilizer is projected to grow at a rate of 2.3% per year over the next decade according to industry analysts. The ever-increasing world population and the need for adequate food supplies ensure the long-term growth for the industry. The largest demand growth will occur in China, India, and developing countries in Asia and Latin America. Nearly two-thirds of U.S. DAP export sales in recent years have been to China and India. Changes in world production and trade patterns, however, especially related to India, have affected U.S. producers significantly. The drop in exports in 2000 was attributed more to supply and demand issues than the effect of new DAP/MAP plants that have opened in Australia and India. The full impact of the new plants on world trade is expected to occur in late 2001 when they should be operating at near rated capacity. Future trade to India also will depend upon government subsidy programs that limit imports.

China has become the most important export market for domestic fertilizers. China has abundant phosphate rock reserves and is a major exporter, but it lacks fertilizer production capacity. Several phosphate fertilizer production facilities are set to open within 5 years, but imports will still be necessary for some time. As demonstrated in 2000, Chinese demand has been very inconsistent and has been affected by low grain prices, use of cheaper NPK compounds, an effort to limit imports, and high inventories. U.S. exports to China and India are expected to be less in 2001, but the potential for sales to China would improve if the country were accepted as a member

of the WTO. Shipments of fertilizer to Latin American have increased but will not fully replace lost sales to India and China.

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TABLE 1
SALIENT PHOSPHATE ROCK STATISTICS 1/

(Thousand metric tons and thousand dollars unless otherwise specified)

	1996	1997	1998	1999	2000
United States:					
Mine production (crude ore)	179,000	166,000	170,000	161,000	163,000
Marketable production:	45,400	45,900	44,200	40,600	38,600
P_2O_5 content	13,300	13,300	12,900	11,800	11,200
Value	$1,060,000	$1,080,000	$1,130,000	$1,240,000	$932,000
Average 2/ dollars per metric ton	$23.40	$24.40	$25.46	$30.56	$24.14
Sold or used by producers: 3/	43,500	42,100	43,700	41,600	37,400
P_2O_5 content	12,900	12,200	12,700	12,100	10,900
Value 4/	$1,020,000	$1,030,000	$1,130,000	$1,310,000	$909,000
Average dollars per metric ton	$23.40	$24.50	$25.87	$31.49	$24.29
Exports:	1,570	335	378	272	299
Value	$56,200	$11,700	$16,100	$11,400	$12,100
Average dollars per metric ton	$35.82	$34.80	$42.70	$41.96	$40.38
Imports for consumption e/ 5/	1,800	1,830	1,760	2,170	1,930
C.i.f. value e/	$104,000	$91,800	$92,700	$123,000	$99,800
Average dollars per metric ton	$57.91	$50.19	$52.66	$56.54	$51.75
Consumption e/ 6/	43,700	43,600	45,000	43,500	39,000
Stocks, December 31, producers	6,390	7,910	7,920	6,920	8,170
World, production, gross weight	135,000	143,000	144,000	137,000 r/	133,000 e/

e/ Estimated. r/ Revised.

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

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

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

TABLE 2
ACTIVE PHOSPHATE ROCK MINES IN THE UNITED STATES IN 2000

Owner	Mine	County and State
Agrifos, L.L.C.	Nichols 1/	Polk, FL.
Agrium Inc.	Rasmussen Ridge	Caribou, ID.
Astaris, L.L.C.	Dry Valley	Do.
Cargill Fertilizer, Inc.	Hookers Prairie	Polk, FL.
Do.	South Fort Meade	Do.
CF Industries, Inc.	South Pasture	Hardee, FL.
IMC Phosphates MP Inc.	Four Corners	Hillsborough, FL.
Do.	Fort Green	Polk, FL.
Do.	Hopewell	Hillsborough, FL.
Do.	Kingsford	Polk/Hillsborough, FL.
Monsanto Co.	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.
J.R. Simplot Co.	Smoky Canyon	Caribou, ID.

1/ Ceased operations in August 2000.

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			Ending stocks, rock
			Beneficiated			
	Rock	P_2O_5 content	Rock	P_2O_5 content	Value 2/	
1999	161,000	15,900	40,600	11,800	1,240,000	6,920
2000:						
January-June:						
Florida and North Carolina	79,900	7,430	17,400	5,100	421,000	6,440
Idaho and Utah	3,680	797	2,740	796	70,900	1,620
Total	83,600	8,220	20,100	5,890	492,000	8,060
July-December:						
Florida and North Carolina	75,100	6,810	15,900	4,640	384,000	6,620
Idaho and Utah	3,880	873	2,560	717	57,000	1,550
Total	78,900	7,680	18,500	5,350	441,000	8,170
Grand total	163,000	15,900	38,600	11,200	932,000	XX

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 (percentage of BPL content 2/)	Rock	P_2O_5 content	Value 3/
1999	41,600	12,100	1,310,000
2000:			
January-June:			
60 to less than 66	17,400	5,100	425,000
Other 4/	1,670	482	38,300
Total	19,100	5,580	464,000
July-December:			
60 to less than 66	15,600	4,560	380,000
Other 4/	2,710	725	65,400
Total	18,400	5,280	445,000
Grand total	37,400	10,900	909,000
Florida and North Carolina	31,900	9,340	774,000
Idaho and Utah	5,470	1,520	134,000

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 (percent BPL content 1/)	1999			2000		
	Domestic	Export	Average	Domestic	Export	Average
70 to less than 72	W	W	W	W	W	W
66 to less than 70	31.27	W	31.36	30.06	W	30.06
60 to less than 66	30.08	W	32.03	24.27	W	24.36
Weighted average 2/	30.56	41.96	31.49	24.20	40.38	24.29

W Withheld to avoid disclosing company proprietary data.
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	1999	2000
Canada	37	33
Netherlands	160	181
Other	75 r/	85
Total	272	299

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

Source: U.S. Census Bureau.

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

(Thousand metric tons)

Country	1999	2000
Argentina	8	16
Australia	205	110
Bangladesh	123	18
Brazil	82	162
Canada	10	6
Chile	62	67
Japan	52	51
Peru	8	10
Uruguay	5	2
Other	79	103
Total	634	545

Source: U.S. Census Bureau.

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

(Thousand metric tons)

Country	1999	2000
Argentina	167	223
Australia	429	413
Brazil	16	120
Canada	102	109
China	4,580 r/	4,060
Colombia	78	97
Ecuador	62	42
India	2,340	345
Japan	334	356
Kenya	114	98
Mexico	256	295
Pakistan	355	295
Thailand	239	204
Other	787	577
Total	9,860 r/	7,240

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

Source: U.S. Census Bureau.

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

(Thousand metric tons)

Country	1999	2000
Australia	432	491
Brazil	306	283
Canada	514	861
Chile	26	8
Colombia	105	108
Guatemala	34	43
Japan	123	127
Mexico	77	52
Thailand	25	16
Other	147	307
Total	1,790	2,300

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

Source: U.S. Census Bureau.

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

(Thousand metric tons)

Country	1999	2000
Australia	118	65
Canada	25	29
India	189	149
Other	67 r/	135
Total	399	378

r/ Revised.
1/ Excludes superphosphoric acid tonnage.

Source: U.S. Census Bureau.

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

	1999		2000	
Country	Quantity (metric tons)	Value 2/ (thousands)	Quantity (metric tons)	Value 2/ (thousands)
Brazil	145	$218	5	$14
Canada	841	1,460	693	1,400
Japan	2,100	3,710	1,210	2,670
Korea, Republic of	154	292	--	--
Mexico	1,970	4,340	1,260	2,610
Netherlands	--	--	17	27
Other	531	1,060	262	504
Total	5,740	11,100	3,440	7,220

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

Source: U.S. Census Bureau.

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

(Thousand metric tons and thousand dollars)

Phosphatic materials	1999		2000	
	Quantity	Value 2/	Quantity	Value 2/
Natural calcium phosphates, unground 3/	92	4,150	186	5,750
Natural calcium phosphates, ground 3/	653	38,800	479	28,600
Total calcium phosphates 4/	2,170	123,000	1,930	99,800
Dicalcium phosphate	7	7,720	8	9,300
Elemental phosphorus	2	4,190	3	5,570
Normal superphosphate	(5/)	6	(5/)	9
Triple superphosphate	64	10,400	3	430
Diammonium phosphate	36	8,360	123	21,900
Fertilizer containing nitrates and phosphates	114	7,810	79	7,220
Phosphoric acid	1	251	(5/)	70

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 U.S. Census Bureau.
4/ Includes an estimate for data suppressed by U.S. Census Bureau.
5/ Less than 1/2 unit.

Source: U.S. Census Bureau.

TABLE 13
PHOSPHATE ROCK ANNUAL WORLD PRODUCTION CAPACITY, DECEMBER 31, 2000 1/

(Thousand metric tons)

Region/country	Capacity
United States	44,800
Africa	53,100
Asia	33,600
Europe and Russia	13,800
Middle East	14,600
Latin America and Canada	8,380
Oceania	3,400
Total	172,000

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				
	1996	1997	1998	1999	2000 e/	1996	1997	1998	1999	2000 e/
Phosphate rock: 3/										
Albania e/	2	1	1	1	1	(4/)	(4/)	(4/)	(4/)	(4/)
Algeria	1,051	1,063	1,115	1,096 r/	875	320	330 e/	358 e/	340 r/ e/	265
Australia e/	1 5/	1	1	2	540	(4/) 5/	(4/)	(4/)	(4/)	150
Brazil	3,823	4,270	4,421	4,300 r/	4,900	1,353	1,500	1,560	1,528 r/	1,740
Chile	17	13	15	15 e/	15	5	3	4	4 e/	4
China e/	21,000	24,500	25,000	20,000 r/	19,400	6,300	7,530	7,500	6,000 r/	5,820
Christmas Island e/	600	600	600	600	575	198	198	198	198	190
Colombia	40	45	73 r/ e/	75 r/ e/	75	8	9	14 r/ e/	14 r/ e/	14
Egypt 6/	808	1,067 r/	1,076 r/	1,018 r/	1,020	222	310 r/	311 r/	298 r/	300
Finland	667	690	716	734 r/ e/	700	246	254	260	268 r/ e/	250
India	1,432	1,043	1,730	1,750 e/	1,720	387	282	467	473 e/	464
Indonesia	8 e/	1	1	1 r/	1	2 e/	(4/)	(4/)	(4/) r/	(4/)
Iraq e/ 6/	1,000	1,000	1,000	1,000	1,000	300	300	300	300	300
Israel	3,839	4,047	4,067 r/	4,128 r/	4,110	1,201	1,260 r/	1,288	1,310 r/	1,300
Jordan	5,355	5,896	5,925 r/	6,014 r/	5,506 5/	1,765	1,946 r/	1,955 r/	1,985 r/	1,817 5/
Kazakhstan e/	1,700	1,000	100	1,000 r/	1,000	500	290	29	290 r/	290
Korea, North e/	520	520	450	350	350	164	164	142	105	105
Mexico	682	714	756	951 r/	1,052 5/	205	214	227	285 r/	316 5/
Morocco 7/	20,855	23,084	23,587	22,767 r/	21,568 5/	6,552	7,848	7,850	7,500 r/	7,200
Nauru	510	491	487	600 e/	500	194	187	185	230 e/	195
Pakistan e/	10	11 5/	11	12	11	2	2	2	2	2
Peru	103	104	104	104 e/	104	32	32 e/	37	37 e/	37
Philippines e/	30	30	8 r/ 5/	105 r/ 5/	100	10	10	27 r/	35 r/	33
Russia e/	8,300 r/	9,800 r/	10,100 r/	11,400 r/	11,100	3,200 r/	3,800 r/	3,900 r/	4,400 r/	4,300
Senegal e/	1,340	1,570	1,480	1,800	1,800	478	575	540	630	630
South Africa	2,655	2,732	2,739	2,957 r/	2,778 5/	1,036	1,066	1,068	1,153 r/	1,080
Sri Lanka	34	30 r/	38 r/	32 r/	32	12	10	13 r/	11 r/	11
Syria	2,189	2,392	2,496	2,084 r/	2,166 5/	670	730	765	635 e/	658
Tanzania	28	3	2	2 e/	2	9	1	1	1 e/	1
Thailand	4	4	3	4	3 5/	1	1	1	1 r/	1
Togo	2,731	2,631	2,250	1,700 e/	1,370	980	955	812	610 e/	500
Tunisia	7,167	6,941	7,901	8,006 r/	8,339 5/	2,150	2,140	2,370	2,400 e/	2,500
United States	45,400	45,900	44,200	40,600	38,600 5/	13,300	13,300	12,900	11,800	11,200 5/
Uzbekistan e/	--	--	100	150	300	--	--	17	25	50
Venezuela	148	291	322	366 r/	375	40	79	87	99 r/	101
Vietnam e/	475	834	860	850	850	143	250	258	255	255
Zimbabwe, concentrate e/	123 5/	94	91	90	90	39	30	29	29	29
Total	135,000	143,000	144,000	137,000 r/	133,000	42,000 r/	45,600 r/	45,400 r/	43,200 r/	42,100
Basic (Thomas converter) slag: e/										
Egypt	8	8	8	8	8	2	2	2	2	2
France	77	44	45	50	50	14	8	8	8	8
Germany	125	125	125	150	150	19	19	19	19	18
Luxembourg	500	500	500	475	475	75	75	75	75	75
Total	710	677	678	683	683	110	104	104	104	103
Guano, Philippines e/	5	5	5	5	-- 5/	2	2	2	2	-- 5/

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

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

2/ Table includes data available through May 8, 2001. 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.

3/ In addition to the countries listed, Canada and Nigeria produced phosphate rock, but output is not reported quantitatively, and available information is inadequate for formulation of reliable estimates of output levels.

4/ Less than 1/2 unit.

5/ Reported figure.

6/ Beneficiated.

7/ Includes production from Western Sahara.