





The Phosphate Market: "From Rocks to Crops" – The Phosphate Market Overview A compilation of Articles and Charts on the Phosphate Rock and Fertilizer Industry May 2013

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JOURDAN

About Jourdan



- Jourdan Resources Inc. is a Canadian junior mining exploration company trading under the symbol JOR on the TSX Venture Exchange.
- The Company is focused on the acquisition, exploration, development and production of phosphate mining properties in Quebec.
- Phosphates are used primarily in the manufacture of fertilizers for the agricultural industry.
- JOR also owns the Vallée Lithium Project which is located adjacent to Canada Lithium's Quebec Lithium Mine which is in the commissioning phase of an open-pit mine and on-site processing plant with estimated capacity to produce approximately 20,000 tonnes of battery-grade lithium carbonate annually.



Plant Requirements – Fertilizer



Nitrogen Phosphorous Potassium

Calcium
Magnesium
Sulphur

•Fe Iron

•B Boron

•Zn Zinc

•Cu Copper

•Mn Manganese

•Mo Molybdenum

•Cl Chlorine

•H₂O Water

•CO₂ Carbon Dioxide





Phosphate Industry

The phosphate industry is a key component of global food security and the phosphorous derived from rich rock phosphate is essential to all forms of life.

In addition to water and sunlight, plants have a vital need for three components that are essential to their harmonious development: nitrogen (N), phosphorous (P), and potassium (K). Arable land naturally contains these three elements in varying proportions. Until the first decades of the 20th century, the growth of agricultural production did not require large inputs of these elements. Between 1900 and 2000, however, agricultural production increased by 600 percent. Now, between 40 percent and 60 percent of global food production requires the use of NPK fertilizer. Phosphorous alone

represents a quarter of a million tons of consumed nutrients.



Essential Phosphate Fertilizers Answer The New Challenge To Feed The World In 2050

If global agricultural production does not increase in this decade compared to the previous, the global output of food could see a shortfall by 2050 when the world's population is anticipated to be 9.2 billion people. At the same time, arable land per capita will fall by .20 to .12 by 2050.

Food production must increase by 70 percent, or 1.5 percent per year. This would be impossible without the use of chemical fertilizers. For example, cereal production will have to grow at this pace to enable consumption equivalent to that of today, namely between 400 and 1,500 daily grams per person worldwide.

To provide the means to meet the planet's future dietary needs in a straightforward and effective way, industrial fertilizers, particularly phosphate fertilizers, are essential. They are the only way for populations to substantially increase yields per hectare and therefore limit the amount of land devoted to agriculture at the expense of an already strained forest cover.



Global demand for phosphate and fertilizer to rise sharply during the next ten years

From 50 million tons at present, demand for fertilizer will increase to around 70* million tons in 2020, an average growth of 2.6 percent per year. Therefore, 2 million additional tons of fertilizer will need to be produced each year.

*Source: British Sulfur, SRI International, Fertecon.



New Production, Lower Grades

- China focused on domestic market
 - Grades are fairly poor compared to traditional markets.
 - Little possibility of international supply.
- US Mines facing severe depletion
- One ton of phosphate produces 130 tonnes of grain.
- Very few mines with production capability exceeding this decade
- US and Canadian corporations becoming increasingly dependent on Morocco and Tunis for product.



Despite receiving less press than the oil and gas industry, the MENA (Middle East and North Africa) region is a major player in the phosphate market, with more than 80 percent of the world's phosphate reserves

Morocco

With an estimated 50 billion tons of reserves, or 75 percent of world reserves, it is no surprise that phosphate represents the largest share of Morocco's economy. State-run monopoly phosphate producer OCP intends to invest roughly US \$8.8 billion in the next ten years to increase phosphate ore production by 20 million tonnes to 47 million tonnes per year by 2020. As a result, Morocco is set to become a major phosphate supplier to African and Asian economies facing rising fertilizer demand over the next decade.

While eluding most of the political turmoil experienced in other Arab Spring protests, Morocco is facing employment and wealth equity concerns. Over the past month, members of the National Union of Phosphate Labourers have undertaken strikes and protests over salaries and social benefits. The protesters have gone so far as to threaten collective suicides, but to date have not disrupted production. Representatives for the union have said that their actions represent "a warning" to OCP in hopes "to fix the problem."

While tensions are not yet overheated, the desperation in many increasingly poor mining cities like Safi and Ben Guerir could lead to greater problems if not adequately handled by government officials.

Tunisia

The initial flash point for Arab Spring protests, Tunisia has suffered the biggest fallout from the 2011 protests and political transitions. State-run Gafsa Phosphate Company (CPG) recently reported significant losses due to political turmoil. Annual phosphate sales fell by more than half to below 3 million tons, while extracted phosphate fell by nearly 10 million tons to below 3 million in 2011.

The financial results were also severe. CPG recently announced that it was unable to honor its commitments with customers such as India, Poland, and Iran.

Thirteen months after initial protests, increased political freedom and the absence of government and military repression appear unlikely to offer Tunisia immediate post-revolt economic returns. Currently, political protests over the lack of sufficient political restructuring and increasing unemployment rates threaten to immobilize phosphate exports from the world's seventh largest phosphate producing country well into 2012.



Despite receiving less press than the oil and gas industry, the MENA (Middle East and North Africa) region is a major player in the phosphate market, with more than 80 percent of the world's phosphate reserves (cont.)

Jordan

A three day strike that disrupted operations at Jordan Phosphate Mines Company has reportedly been resolved as workers have accepted plans to improve working conditions offered by the Jordanian Ministry of Industry. While Jordan is one of the least significantly impacted of the MENA region phosphate producers, it is currently undergoing domestic criticisms, primarily from company employees, following the recent privatization of Jordan Phosphate.

Producing approximately 7 million tonnes of phosrock annually, Jordan Phosphate is the sixth largest phosrock producer and the third largest exporter of phosphate globally. Seen as one of the safest investment jurisdictions in the MENA region, foreign investment constitutes approximately 37 percent of Jordan Phosphate's ownership.

Syria

In the grips of what has been described as a civil war, Syria and its phosphate industry are currently facing the most severe conditions in the region. With transportation and production disruptions from protests, Syria's 1.8 billion ton phosphate reserves and sixth largest national industry is now also preparing for severe export sanctions internationally. Last week, European Union governments agreed, in principle, to ban trade of Syrian phosphate exports; Europe imports roughly 40 percent of Syria's phosphate exports.

Until recently, Syria's phosphate industry had been enjoying strong growth, with more than US \$320 million a year in sales in 2010. Mining operations are dominated by the state-run General Company for Phosphate and Mines (GECOPHAM), but mineral processing is also controlled by the General Fertilizers Company (GFC), which produces phosphoric acid and triple superphosphate (TSP) fertilizer. However, underinvestment in its refining capacity means that the majority of Syrian phosrock production is exported.





Peak Phosphorous

Mining phosphorus for fertilizer is consuming the mineral faster than geologic cycles can replenish it. The U.S. may run out of its accessible domestic sources in a few decades, and only a few other countries have substantial reserves, which could also be depleted in about a century.

Oil price swings have shown, markets can tighten long before a given resource is anywhere near its end. And reserves of phosphorus are even less cevenly distributed than oil's, raising additional supply concerns. The U.S. is the W world's second-largest producer of phosphorus (after China), at 19 percent of a the total, but 65 percent of that amount comes from a single source: pit mines near Tampa, Fla., which may not last more than a few decades. Meanwhile C nearly 40 percent of global reserves are controlled by a single country, n Morocco, sometimes referred to as the "Saudi Arabia of phosphorus." a Although Morocco is a stable, friendly nation, the imbalance makes y phosphorus a geostrategic ticking time bomb.

Altogether, phosphorus flows now add up to an estimated 37 million metric tons per year. Of that, about 22 million metric tons come from phosphate mining. The earth holds plenty of phosphorus-rich minerals—those considered economically recoverable—but most are not readily available. The International Geological Correlation Program (IGCP) reckoned in 1987 that there might be some 163,000 million metric tons of phosphate rock worldwide, corresponding to more than 13,000 million metric tons of phosphorus, seemingly enough to last nearly a millennium. These estimates, however, include types of rocks, such as high-carbonate minerals, that are impractical as sources because no economical technology exists to extract the phosphorus from them. The tallies also include deposits that are inaccessible because of their depth or location offshore; moreover, they may exist in underdeveloped or environmentally sensitive land or in the presence of high levels of toxic or radioactive contaminants such as cadmium, chromium, arsenic, lead and uranium.

Phosphorus reserves are also concentrated geographically. Just four countries—the U.S., China, South Africa and Morocco, together with its Western Sahara Territory—hold 83 percent of the world's reserves and account for two thirds of annual production. Most U.S. phosphate comes from mines in Florida's Bone Valley, a fossil deposit that formed in the Atlantic Ocean 12 million years ago. According to the U.S. Geological Survey, the nation's reserves amount to 1,200 million metric tons. The U.S. produces about 30 million metric tons of phosphate rock a year, which should last 40 years, assuming today's rate of production.

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Mining companies have the incentive to do exploration only once a resource's lifetime falls below a certain number of decades. But the depletion of old mines spurs more exploration, which expands the known resources.



The 'peak phosphorus' debate: how long will global phosphate rock reserves last?

The extent of global phosphate rock reserves is difficult to ascertain. Knowledge of phosphate rock deposits is evolving, along with technology and the economics of production (IFDC/UNIDO 1998). How long reserves will last depends on their size, quality and rate of use. Researchers have raised concern about 'peak phosphorus', the proposition that economic and energy constraints will set a maximum level for phosphate rock production, which will then decrease as demand for phosphorus increases. Many scientists and industry experts contest the specific assertions that have been made regarding when such a peak is likely to occur. For example, Cordell et al. (2009) estimated that peak production of current reserves (that is, phosphate rock known to be economically available for mining and processing) would occur between 2030 and 2040. That estimate was based on United States Geological Survey (USGS) data for global phosphate reserves (Jasinski 2006, 2007 and 2008). Increasingly experts now consider the extent of these reserves to have been underestimated (Van Kauwenbergh 2010). The most recent USGS estimates have been revised upward (Jasinski 2011). Proponents of the peak phosphorus theory argue that even if the timeline may vary, the fundamental issue, that the supply of cheap and easily accessible phosphorus is ultimately limited, will not change.

Phosphate rock is the only new source of phosphorus entering the food production chain. The consistency and volume of food production therefore depend on the accessibility of phosphorus to farmers. Given the difficulties of estimating the longevity of phosphate rock reserves and the vital importance of decision-making based on reliable and transparent information concerning world phosphate rock resources and reserves, IFDC recommends establishing an international, multi-disciplinary network to regularly update a definitive database on phosphate rock deposits



Recent Phosphate News

- Jeremy Grantham, the famed and gloomy U.S. contrarian investor, has a few hot tips for people who want to make a lot of money over the next few years: Buy natural gas, copper ore and **phosphorus miners**. Globe and Mail, April 11, 2013.
- "By allowing us to mine phosphates in Sde Barir, we will invest hundreds of millions of dollars and will be able to secure reserves for around 30 years," Borgas said. "But <u>if we do not</u> <u>receive the licenses</u>, it means that we will <u>have to stop our Israeli phosphate activities</u> <u>within 10 years</u>." ICL, the second-largest company by market value on the Tel Aviv exchange, is controlled by conglomerate Israel Corp. Reuters, April 10, 2013.
- MPA has managed to secure a long-term supply contract from El Nasr and they will provide us 600,000 tonnes of rock phosphate, annually, valued at US\$90 million (US\$150 per tonne for ~30%P₂O₅). Business Time, April 4, 2013.



Future Food Shortages?

Food shortages in the future?

April 15. 2013 11:48AM

American households, according to a speaker at the American Chemical Society's meeting in New Orleans, throw away 40 percent of the food they buy.

Globally, the story is much the same. A study by the UK Institution of Mechanical Engineers found that somewhere between 30 percent and 50 percent of all the food grown in the world never makes it to the plate. Up to 2 billion tons of food is devoured or tainted by rats, mice and other pests, or perishes in granaries, or is discarded by buyers because it doesn't meet supermarket standards.

That so much food is grown, distributed and sold every day is a reminder that free markets can effectively deliver whatever people can afford. That so much is shamefully wasted when so many people go hungry is a reminder that free markets do not and cannot trade in what George Orwell, in the hungry depression years, called justice and common decency.

But food security is not just a problem for the poor. It will become, increasingly, a problem for everybody. That is because of population growth. Every day, there are another 220,000 mouths to feed. By 2030, the world will be home to eight billion people; by 2050, there will be nine billion.

There is only so much you can expect from photosynthesis. That per capita income for hundreds of millions of once-poor people in Asia and Africa has risen is good news. The bad news is that the world appetite for meat is also rising, which pushes up the price and reduces the supply of wheat, rice, maize and other staples for the poorer communities.

Huge tracts of the planet are already experiencing water stress. The oil that fuels the world's tractors is a finite resource; cheap phosphorus fertilizer cannot be guaranteed indefinitely.

According to the U.N., 2013 could turn out very badly. Food, either wasted on the plate or withered in the soil, is a problem for the world's politicians, and one that becomes increasingly ominous, everywhere, with each successive harvest.

RESSOURCES

The Guardian of London

UN warns of looming worldwide food crisis in 2013

UN warns of looming worldwide food crisis in 2013

- Global grain reserves hit critically low levels
- Extreme weather means climate 'is no longer reliable'
- Rising food prices threaten disaster and unrest

John Vidal, The Observer, Saturday 13 October 2012 19.35 BST

A Zimbabwean peasant farmer in a crop of maize destroyed by drought. One expert warns: 'The geopolitics of food is fast overshadowing the geopolitics of oil.' Photograph: Howard Burditt/Reuters

World grain reserves are so dangerously low that severe weather in the United States or other food-exporting countries could trigger a major hunger crisis next year, the United Nations has warned.

Failing harvests in the US, Ukraine and other countries this year have eroded reserves to their lowest level since 1974. The US, which has experienced record heatwaves and droughts in 2012, now holds in reserve a historically low 6.5% of the maize that it expects to consume in the next year, says the UN.

"We've not been producing as much as we are consuming. That is why stocks are being run down. Supplies are now very tight across the world and reserves are at a very low level, leaving no room for unexpected events next year," said Abdolreza Abbassian, a senior economist with the UN Food and Agriculture Organisation (FAO). With food consumption exceeding the amount grown for six of the past 11 years, countries have run down reserves from an average of 107 days of consumption 10 years ago to under 74 days recently.

Prices of main food crops such as wheat and maize are now close to those that sparked riots in 25 countries in 2008. FAO figures released this week suggest that 870 million people are malnourished and the food crisis is growing in the Middle East and Africa. Wheat production this year is expected to be 5.2% below 2011, with yields of most other crops, except rice, also falling, says the UN.

The figures come as one of the world's leading environmentalists issued a warning that the global food supply system could collapse at any point, leaving hundreds of millions more people hungry, sparking widespread riots and bringing down governments. In a shocking new assessment of the prospects of meeting food needs, Lester Brown, president of the Earth policy research centre in Washington, says that the climate is no longer reliable and the demands for food are growing so fast that a breakdown is inevitable, unless urgent action is taken.



UN warns of looming worldwide food crisis in 2013 (cont.)

"Food shortages undermined earlier civilisations. We are on the same path. Each country is now fending for itself. The world is living one year to the next," he writes in a new book.

According to Brown, we are seeing the start of a food supply breakdown with a dash by speculators to "grab" millions of square miles of cheap farmland, the doubling of international food prices in a decade, and the dramatic rundown of countries' food reserves.

This year, for the sixth time in 11 years, the world will consume more food than it produces, largely because of extreme weather in the US and other major food-exporting countries. Oxfam last week said that the price of key staples, including wheat and rice, may double in the next 20 years, threatening disastrous consequences for poor people who spend a large proportion of their income on food.

In 2012, according to the FAO, food prices are already at close to record levels, having risen 1.4% in September following an increase of 6% in July.

"We are entering a new era of rising food prices and spreading hunger. Food supplies are tightening everywhere and land is becoming the most sought-after commodity as the world shifts from an age of food abundance to one of scarcity," says Brown. "The geopolitics of food is fast overshadowing the geopolitics of oil."

His warnings come as the UN and world governments reported that extreme heat and drought in the US and other major foodexporting countries had hit harvests badly and sent prices spiralling.

"The situation we are in is not temporary. These things will happen all the time. Climate is in a state of flux and there is no normal any more.

"We are beginning a new chapter. We will see food unrest in many more places.

"Armed aggression is no longer the principal threat to our future. The overriding threats to this century are climate change, population growth, spreading water shortages and rising food prices," Brown says.



Production of Phosphate Rock in the Top Four Producing Countries



Production Shares of the Top Four Producing Countries





Global Production Capacity of Phosphate Rock



Global Production Capacity of Phosphate Rock



IFA: GLOBAL PHOSPHATE ROCK PRODUCTION TRENDS FROM 1961 TO 2010 Reasons for the temporary set-back in 1988-1994

Phosphate Product Export Distribution

Percent Based on Product Tonnes - 2010



World Phosphate Use By Country

MILLION TONNES P2O5

SOURCE: IFA MAY 2012



2010-11 Major World Phosphate Rock Producers





Figure 2. World Mine Production of Phosphate Concentrate, 1945-1981



Source: http://cerosdata.bigkidlondon.com/web-assets/rbi/rbi-chemicals-icic-map_mar_2012/

Global Phosphate Deposits and Production



Sources: USGS Mineral Commodity Summaries, Phosphate Rock, 2012 and USGS Open File Report 02-156



Global Phosphate Rock Trade Routes



Source: http://cerosdata.bigkidlondon.com/web-assets/rbi/rbi-chemicals-icic-map_mar_2012/



World Phosphate Rock Production and Demand



Top 10 World Phosphoric Acid Producers by Capacity



World Phosphoric Acid Capacity Additions





http://www.potashcorp.com/industry_overview/2011/

World Phosphoric Acid Production and Operating Rate





http://www.potashcorp.com/industry_overview/2011/

Global Phosphorus Fertilizer Consumption



Demand in developed countries reached a plateau and then declined around 1990. It has continued to increase steadily in developing countries.



Source: Heffer and Prud'homme (2010), UNEP Yearbook 2011

Global Supply/Demand Balances: 2010 – 2011 – 2012

Products			2010	2011	2012
Nitrogen	Supply*		133.7	137.0	139.5
Mt N	Demand**		129.2	134.2	137.0
		Potential balance	+4.5	+2.8	+2.5
Urea	Supply		155.6	158.9	167.1
Mt urea	Demand		149.6	155.3	163.6
		Potential balance	+6.0	+3.6	+3.5
Phosphoric acid	Supply		42.0	43.9	45.7
Mt P ₂ O ₅	Demand		39.0	41.9	43.4
		Potential balance	+3.0	+2.0	+2.3
Potash	Supply		36.6	38.5	40.3
Mt K ₂ O	Demand		30.7	32.7	33.8

Phosphate Rock (and hence Phosphoric Acid) availability and has been disrupted by political instability in Syria, Egypt, Tunisia and Algeria in 2012 and the forecast Potential balance of 2.3 Mt will likely be a negative balance for 2012 where supply will not meet all demand.

* Supply = effective capacity (capability)

** Demand = all uses: fertilizers, industrial uses, losses, unallocated tonnages.

Source: IFA Production and International Trade Committee – December 2011



Global Fertilizer Demand (Mt nutrients)

	Ν	P_2O_5	K ₂ O	Total
07/08	100.5	38.4	28.9	167.9
08/09	97.7	33.7	23.4	154.8
09/10	101.9	37.5	23.5	162.9
10/11	104.1	40.5	27.6	172.2
Change	+2.2%	+8.0%	+17.4%	+5.7%
11/12 (e)	108.2	41.0	27.7	177.0
Change	+4.0%	+1.4%	+0.4%	+2.8%
12/13 (f)	109.8	42.2	29.4	181.4
Change	+1.4%	+2.9%	+6.0%	+2.5%
2016/17 (f)	114.7	45.4	32.7	192.8
Average Annual Change*	+1.5%	+2.3%	+3.7%	+2.1%



Mono-Ammonium Phosphate, Phosphate Rock & Sulphur Prices



Sources: (1) Alberta Agricultural Input Monitoring System (AIMS), Alberta Agriculture and Food, Economics and Competitiveness Division, Statistics and Data Development Unit; (2) The United States Geological Survey; (3) US Census Bureau data as adjusted by US Geological Survey and PentaSul North America Sulphur Service; (4) AAFC calculations.



Fertilizer production routes



Relationship of Phosphate Rock and Phosphate Fertilizers



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Phosphate Exploration & Development: "From Rocks to Crops"

