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CANADIAN FARM FUEL AND FERTILIZER: PRICES AND FARM EXPENSES

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CANADIAN FARM FUEL AND FERTILIZER: PRICES AND FARM EXPENSES

This report examines the situation for farm fuel and fertilizer prices and expenses in Canada for 2016 and the outlook for 2017. Expenditures for fuel and fertilizer represented about 15% of farm operating expenses in Canada in 2016. Prices of fuel for farm machinery decreased significantly in 2016 but are expected to increase in 2017. Fertilizer prices decreased in 2016 and are expected to continue declining in 2017.

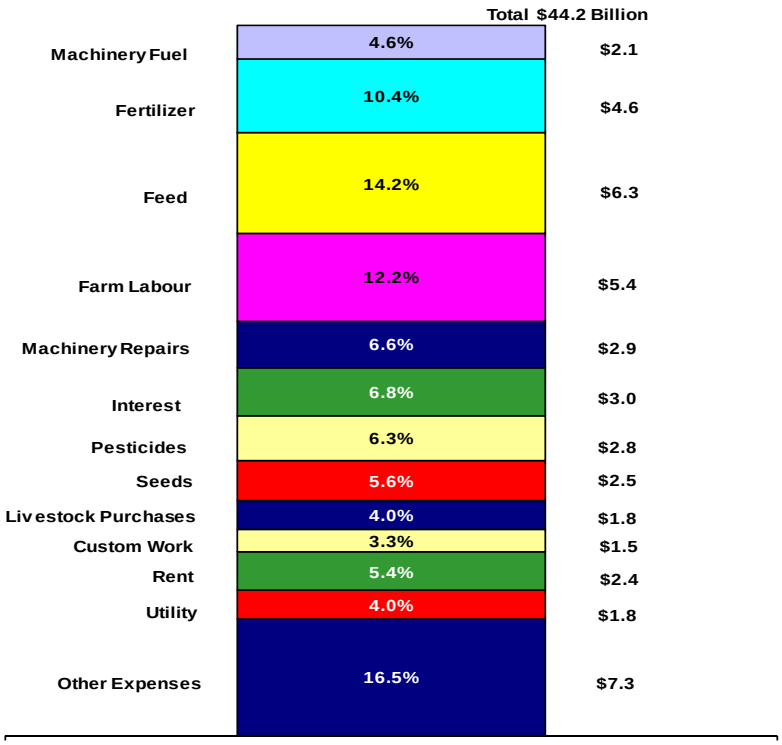
BACKGROUND

Production and profitability in primary agriculture is highly dependent upon fuel and fertilizer. Those are essential inputs for modern agriculture and also represent a significant cost. Figure 1 shows the components Canadian farm operating expenses in 2016.[1] Fuel and fertilizer costs accounted for 15% of total Canadian farm expenses, or $6.7 billion. For every one cent per litre increase in fuel prices, Canadian farmers' annual machinery fuel bill increases by about $29 million in 2017. For fertilizer, every ten dollar per tonne increase in the price adds about $83 million to Canadian farmers' annual fertilizer bill.

[1] Note: (1) Rent includes cash rent and share rent; (2) Utility includes electricity, telephone and heating oil; (3) Other expenses include taxes, repairs to building and fences, irrigation, twine & wire, crop insurance premiums, artificial insemination fees & vet, business insurance, stabilization premiums, legal and accounting fee and other expenses.

Figure 1

CANADA: Farm Operating Expenses, 2016



Sources: (1) Statistics Canada; (2) AAFC calculations.

Fuel prices increased by 123% between 2003 and 2008, but the global recession led demand for energy to weaken and fuel prices fell in 2009. Fuel prices started to rise again in 2010, and this trend continued between 2011 and 2013 because of growing energy demand in emerging economies and slow growth in supply. However, crude oil prices started to drop significantly in October 2014 as Saudi Arabia was no longer willing to cut its oil production to support higher prices. At the same time, global demand growth slowed and a U.S. shale oil boom increased supply. Fuel prices continued to decrease in 2015 due mainly to growing global oil supply and lagging overall demand for fuel.

Natural gas supplies have become more plentiful in North America as a result of advances in horizontal drilling and hydraulic fracturing technologies (fracking) for extracting shale gas. This kept U.S. and Canadian natural gas prices depressed in 2011-2012. In 2013 and 2014, natural gas prices rebounded somewhat in both the U.S. and Canada, driven by increasing demand and declining production, but prices still remained below 2011 levels. Prices started to decrease again in 2015.

Fertilizer prices in Canada began rising steadily in 2003, but increased sharply to reach a historical high in 2008. These increases abruptly halted in 2009 as a result of falling commodity prices, the restricted availability of credit, and a

sudden fall in world energy prices, all results of the global financial crisis. Fertilizer prices resumed their climb in 2011 and continued to increase in 2012. However, prices decreased in 2013 in response to stagnant global fertilizer demand and oversupply in the global markets. Prices remained relatively stable in both 2014 and 2015.

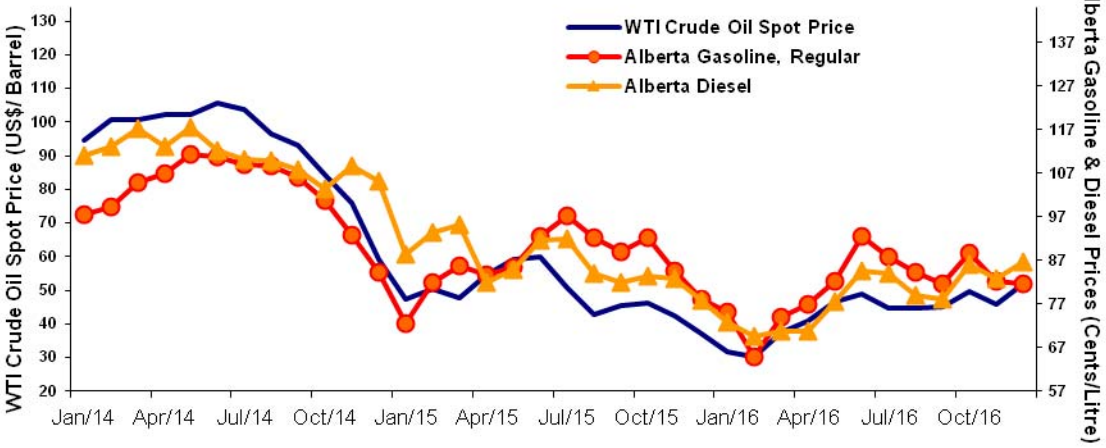
SECTION 1 - FARM MACHINERY FUEL

The Canadian agriculture sector relies heavily on petroleum products to meet a variety of energy needs. Farm machinery fuel expenses consist mainly of diesel and gasoline, but also include lubricants. The price of fuel is generally determined by the forces of global supply and demand, and the agricultural sector is largely a price taker for both diesel and gasoline.

FUEL PRICES

Canadian fuel prices closely follow the U.S. market. Figure 2 shows the recent energy price patterns between U.S. and Canada over 2014-2016. The West Texas Intermediate (WTI) crude oil price averaged about US$43 per barrel in 2016, 11% lower than in 2015.[2] Statistics Canada estimated that the prices paid by Canadian farmers for farm machinery fuel decreased by 11% in 2016 relative to 2015[3].

Figure 2. Monthly Fuel Prices: Alberta and United States, 2014-2016



Source: (1) Alberta Agricultural Input Monitoring System (AIMS), Alberta Agriculture and Forestry, Economics and Competitiveness Branch, Statistics and Data Development Section; (2) United States Energy Information Administration (EIA); (3)

Fuel prices are expected to increase in 2017 due mainly to expected reductions in international crude oil supply and relatively robust global consumption of petroleum products because of a generally positive outlook for the global economy. The U.S. Energy Information Administration (EIA) projected the price for WTI crude oil to average US$49 per barrel in 2017, up 13% from the 2016 average.

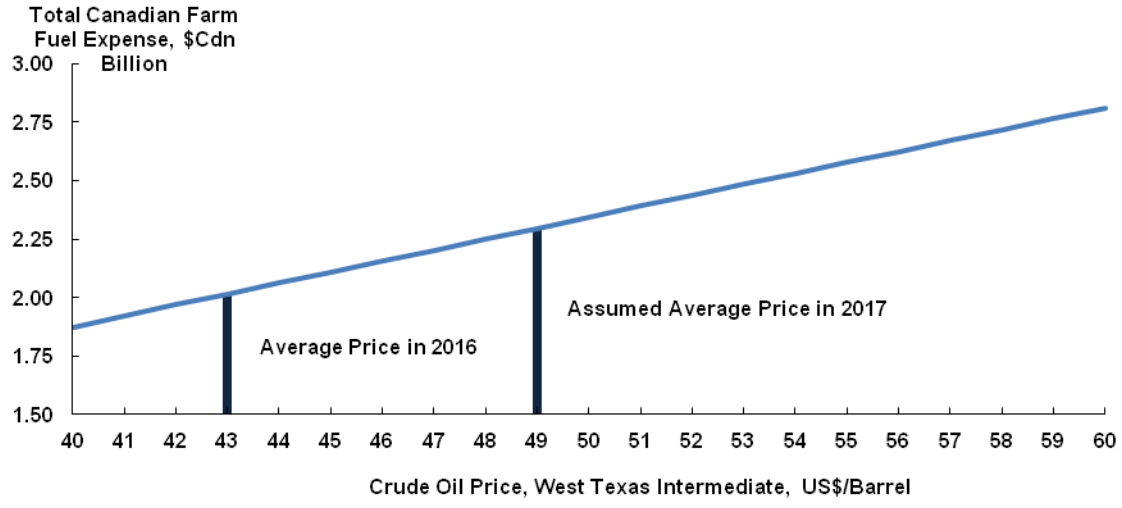
[2] Source: the U.S. Energy Information Administration (EIA),

[3] Source: Table 328-0016, Farm Input Price Index, Statistics Canada.

Based on information available up to July 2017, Agriculture and Agri-Food Canada expects that fuel prices for farm machinery in Canada would increase by about 9% in 2017 compared to 2016. This would translate into a $186 million increase in Canadian farmers' machinery fuel bill for 2017.

Figure 3 shows that for every one U.S. dollar per barrel increase in WTI crude oil price, Canadian farmers' annual machinery fuel bill increases by about $46.9 million in 2017.

Figure 3. Crude Oil Prices Vs Total Machinery Fuel Expenses in 2017

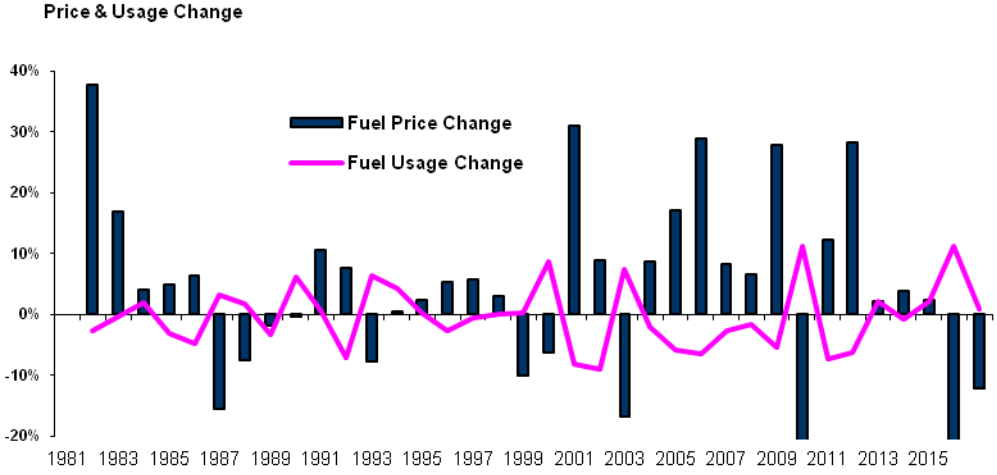


Source: (1) United States Energy Information Administration; (2) AAFC Calculations.

FARM FUEL USAGE

The price elasticity of demand measures the percentage change in quantity demanded of a product resulting from a percentage change in price. Figure 4 illustrates the inverse relationship between fuel price and fuel usage over 1981-2016. Using 36 years of historical data from Statistics Canada, the price elasticity of demand for farm fuel in Canada is estimated at -0.25. This means that, on average, when fuel prices rise 10% Canadian farmers reduce fuel usage by 2.5%. Farmers' demand for fuel is relatively insensitive to price changes in the short-term because fuel is a necessity for farming and there are no immediate substitutes.

Figure 4. Farm Machinery Fuel Price and Usage Change from Previous Year in Canada, 1981-2016



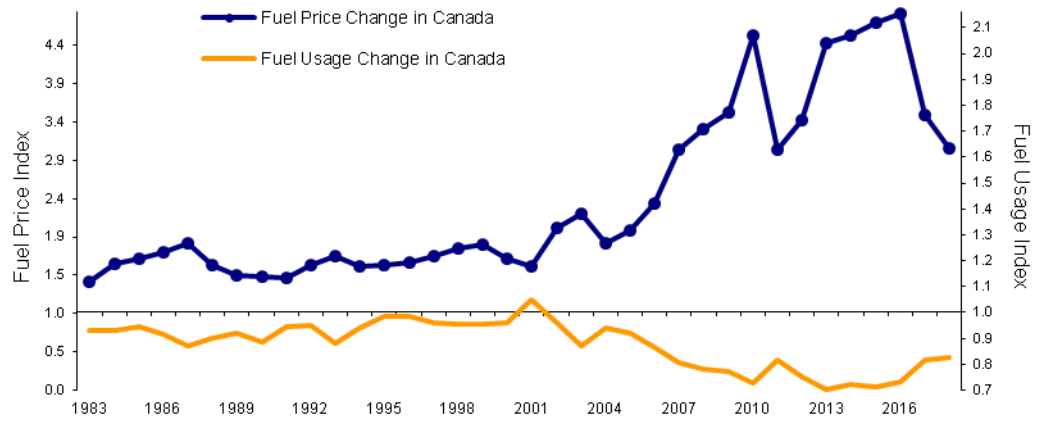
Source: (1) Statistics Canada and AAFC; (2) AAFC calculations.

Figure 5 indicates that before 2000, farmers' long-term fuel usage was actually quite steady, averaging a 0.5% annual growth rate, with reduced variability in fuel prices from 1981 to 1999. However, the volume of fuel used by farmers decreased by an average of 2.1% annually following a string of nearly continuous hikes in fuel prices over 2000-2014. Therefore, the fuel price increase would have to persist for a longer period of time in order to reduce the fuel consumption trend as the short-run fuel demand is very inelastic.

In response to higher fuel prices, farmers have increasingly factored in fuel efficiency into their machinery purchase decisions and have also altered their production practices. Examples of management decisions which farmers can take include switching to no-till or minimum tillage options, matching the tractor to the power requirements of the job, using manure more efficiently as a substitute for fertilizers, etc.[4]

[4] Please read "Tips to Reduce Fuel Consumption", Ontario Ministry of Agriculture, Food and Rural Affairs, http://www.omafra.gov.on.ca/english/engineer/facts/06-091.htm

Figure 5. Long-term Trends in Farm Machinery Fuel Price and Usage (Base Year=1980) in Canada, 1982-2016



Source: (1) Statistics Canada and AAFC; (2) AAFC calculations.

Given the estimated elasticity and other factors such as seeded and harvested area, AAFC estimates Canadian farm machinery fuel usage to be flat in 2017.

FARM FUEL EXPENSES

Given changes in both the price and quantity of farm fuels, Canadian farm machinery fuel expenses were $2.1 billion in 2016, a decrease of 11% over 2015, and below the 2011-2015 average of $2.6 billion. Total expenses for farm machinery fuel are forecast to be $2.2 billion, up 9% in 2017 compared to 2016.

SECTION 2 - FARM FERTILIZERS

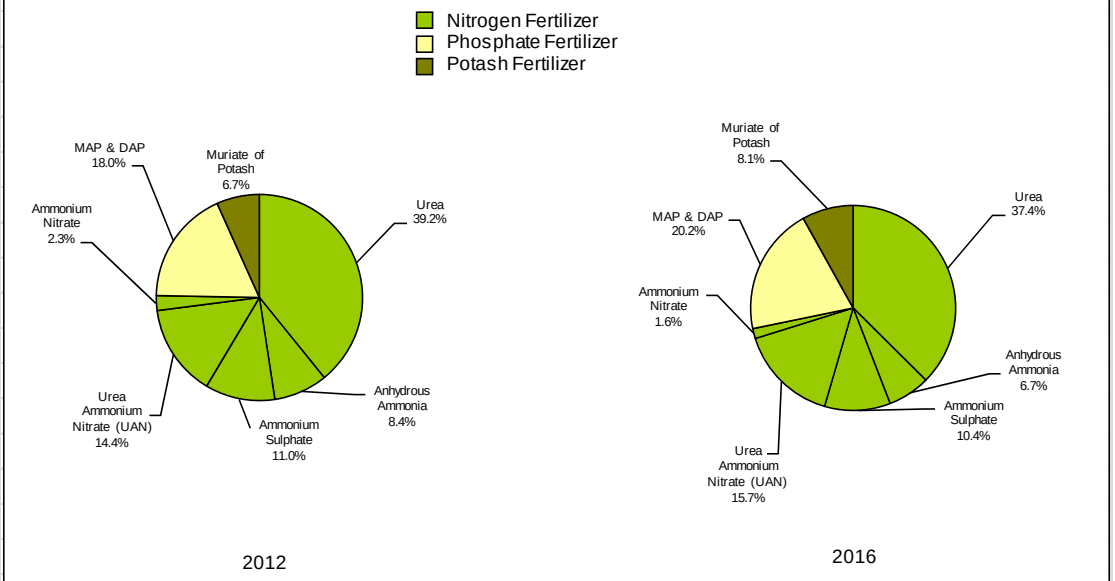
Canada is one of the world's major producers of fertilizers, particularly nitrogen and potash. Production is located primarily in Alberta and Saskatchewan. In 2016, Canada exported about 61% of its potash production and about a quarter of its nitrogen production, mainly to the U.S.

FERTILIZER TYPES IN CANADA

Fertilizers contain one or more of three key nutrients: nitrogen, phosphate and potassium. The nitrogen fertilizers that are currently used in Canadian agriculture are primarily anhydrous ammonia, urea, nitrogen solution, ammonium nitrate and ammonium sulphate. The phosphate fertilizers are monoammonium phosphate (MAP) and diammonium phosphate (DAP), both produced from phosphate rock. The other major nutrient used in crop production is potash fertilizer, which is important in soybean and corn production. The majority of potash production in North America takes place in Saskatchewan.

Figure 6 shows the usage of the major types of fertilizers used in Canadian agriculture in 2012 and 2016. Because of nitrogen’s importance to plant growth and development, nitrogen is the most common nutrient used in agricultural production, accounting for 72% of total fertilizer usage, or about 5 million tonnes in 2016. The usage of nitrogen increased at an annual growth rate of 4% from 2012 to 2016, with urea representing the largest volume used. Phosphate fertilizers accounted for 20% of total fertilizer usage, or about 1.5 million tonnes in 2016. Potash fertilizer accounted for 8% of total usage, or about 0.6 million tonnes in 2016.

Figure 6. Fertilizer Types and Usage in Canadian Agriculture, 2012 and 2016



Sources: (1) Statistics Canada; (2) AAFC calculations.

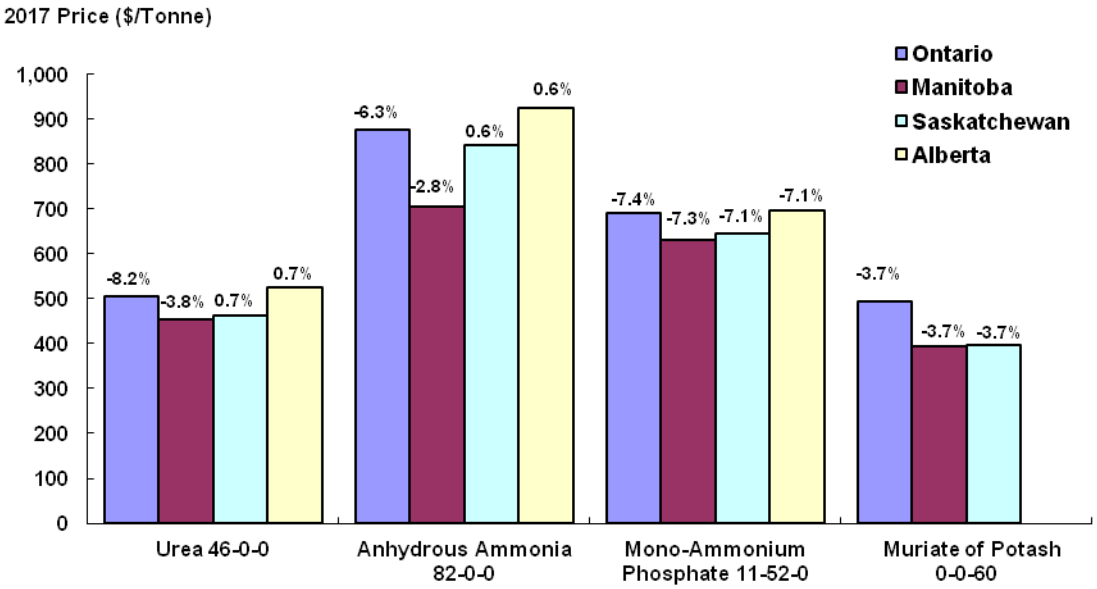
FERTILIZER PRICE TRENDS

Canadian fertilizer prices decreased by about 10% in 2016 compared to 2015 due mainly to a weaker Canadian dollar versus the U.S. dollar. A challenging currency environment coupled with economic weakness contributed to a sluggish demand environment for fertilizer across emerging markets, such as China and India. Meanwhile, global capacity expansion also exerted pressure on fertilizer prices.

Figure 7 shows prices of the major types of fertilizers, as well as the percentage changes of prices in 2017 compared to 2016 in Ontario, Manitoba, Saskatchewan and Alberta.[5] AAFC estimated that the average prices paid for all fertilizers in Canada will continue to decrease by 3% in 2017 as global fertilizer supply continues to increase while fertilizer demand is lackluster.

[5] Based on information available up to July 2017.

Figure 7. Fertilizer Prices for 2017 and Their Year-over-Year Changes, Selected Provinces, 2016 to 2017



Source: (1) AAFC Farm Input Price Survey; (2) Alberta Agricultural Input Monitoring System (AIMS), Alberta Agriculture and Forestry, Economics and Competitiveness Branch, Statistics and Data Development Section; (3) AAFC calculations.

DETERMINATION OF FERTILIZER PRICES

The traditional factors for determining fertilizer prices are production costs, global market demand and supply, and competition. In addition, prices for all three types of fertilizers at the retail level are affected by prices for gasoline and diesel because transportation costs represent an important part of the cost of marketing fertilizer. Other factors, such as exchange rates and government policies, also have an effect on fertilizer pricing.

Production Costs

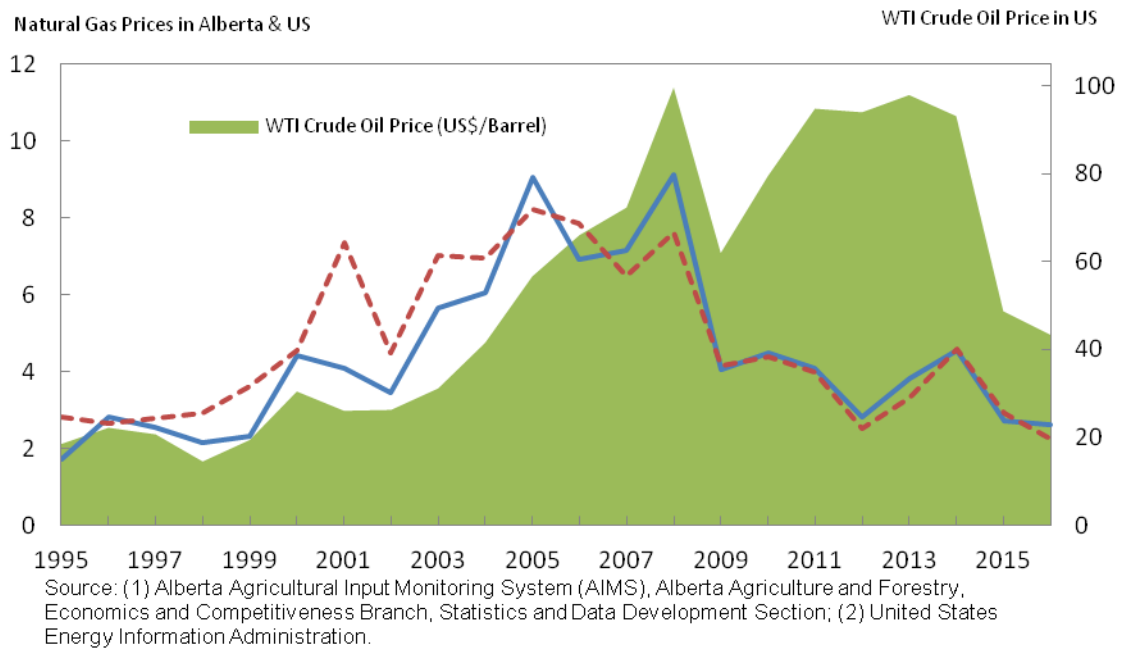
The factors affecting the cost of production are different for each type of fertilizer. The following section will discuss each of the cases for nitrogen, phosphate and potash fertilizers, respectively.

(1) Natural Gas Prices

Anhydrous ammonia is the primary component of nearly all nitrogen fertilizers produced in the world. Ingredients for the production of anhydrous ammonia are air, steam and natural gas, with the latter accounting for 70-90% of the production cost of ammonia. Therefore, natural gas prices are one of the key determinants of nitrogen fertilizer prices.

Figure 8 shows natural gas prices in comparison with crude oil prices in Alberta and the U.S. over 1995-2016. In the past, natural gas and crude oil prices were highly correlated, so that changes in the price of oil translated into changes in the price of natural gas. However, the massive gas supply that has resulted from the proliferation of shale gas wells that began in the U.S. has kept U.S. and Canadian natural gas prices low in recent years, causing natural gas and crude oil prices to decouple from one another after 2010. Though natural gas prices rebounded somewhat in 2013 and 2014, they started to decrease significantly in 2015 and continued to decrease in 2016. The U.S. natural gas Henry Hub spot price averaged US$2.61 per thousand cubic feet in 2016, 4% lower than in 2015. AAFC estimates that the natural gas price in Alberta decreased by 23% in 2016. Looking forward, the U.S. EIA is projecting that natural gas prices will increase in 2017, but still below the 2012-2016 average.[6]

Figure 8. Natural Gas and Crude Oil Prices in Alberta and the United States,



Source: (1) Alberta Agricultural Input Monitoring System (AIMS), Alberta Agriculture and Forestry, Economics and Competitiveness Branch, Statistics and Data Development Section; (2) United States Energy Information Administration.

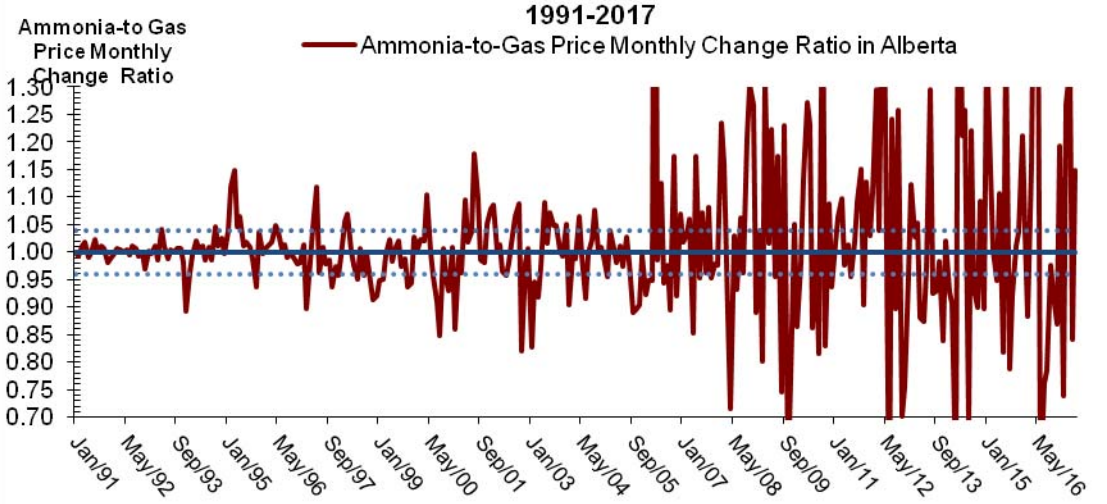
It is important to examine whether the plunging natural gas price has led to lower nitrogen prices in recent years. The ammonia-to-gas monthly price change ratio measures whether or not nitrogen fertilizer prices track natural gas prices. A ratio equal to 1 means that nitrogen prices track natural gas prices. A ratio above 1 indicates that nitrogen prices change at a greater pace than natural gas prices, while a ratio below 1 indicates the reverse. Figure 9 illustrates that the ratios were mostly within ±0.04 of 1 over 1991 to 2006, meaning that the nitrogen

[6] Based on information from the U.S. Energy Information Administration (EIA) in July 2017.

fertilizer price generally tracked natural gas price closely for that period. However, the two prices series appear to have disconnected from one another after 2006 with most of the ratios swinging away from 1.

The correlation coefficient is another indicator that is used to measure the degree to which two variables are associated, with values close to ±1 indicating that the two variables are highly related. The estimated correlation coefficients between natural gas prices and fertilizer prices confirm the previous finding, with an estimated correlation coefficient of 0.81 over 1991-2006, but only 0.17 over 2007-2017. Therefore, natural gas prices appear to have had less impact on fertilizer prices in recent years than they used to as the lower natural gas price leaves more room for fertilizer producers to adjust their prices for the change of various price determinative factors.

Figure 9. Ammonia-to-Gas Price Monthly Change Ratio in Alberta, 1991-2017



Source: (1) Alberta Agricultural Input Monitoring System (AIMS), Alberta Agriculture and Forestry, Economics and Competitiveness Branch, Statistics and Data Development Section; (2) AAFC calculations.

Note: Ammonia-to-gas price monthly change ratio is computed by dividing the monthly change in ammonia price by the monthly change in natural gas price.

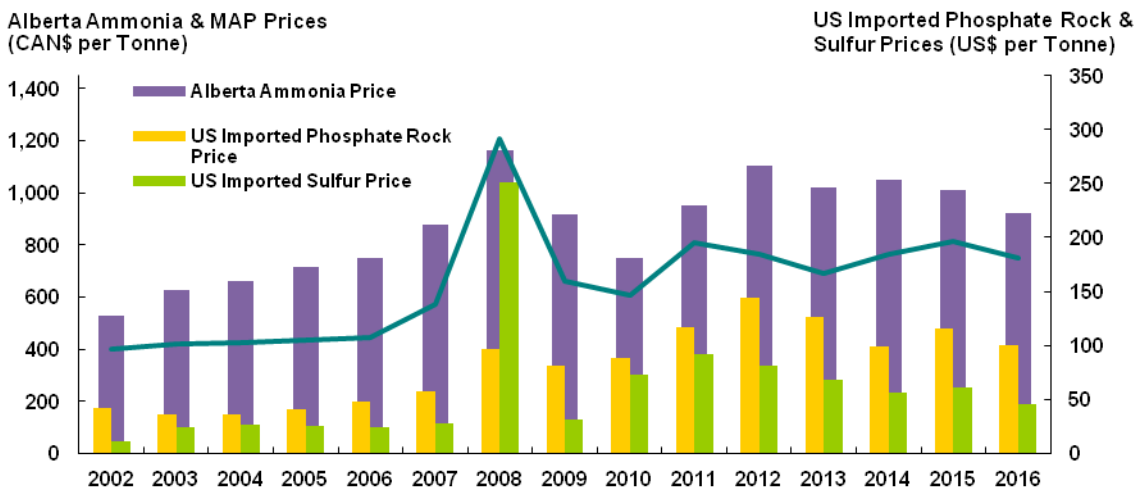
Low natural gas prices, high crop prices and perceived solid demand have led to investment in new fertilizer capacity including the construction of new plants, restarting closed plants, and possible expansion at existing facilities since 2013. As a result, a surge of new fertilizer capacity has started to come on-stream since 2016, which has been putting downward pressure on fertilizer prices.

(2) Ammonia, Phosphate Rock and Sulfur Prices

Ingredients for the production of phosphate fertilizers (MAP and DAP) are ammonia, phosphate rock and sulfur. Figure 10 shows how the volatility of ammonia, phosphate rock and sulfur prices had profound implications on phosphate fertilizer prices over 2002-2016. Although prices of ammonia,

phosphate rock and sulfur generally remained flat with no significant variability until 2006, markets began to tighten in 2007, with prices of these raw materials reaching a peak in 2008. This dramatic increase in raw material prices significantly drove up phosphate fertilizer prices during 2007 and 2008. However, the situation reversed itself in 2009 and 2010, resulting in falling phosphate fertilizer prices. After 2010, phosphate fertilizer prices generally reflected the fluctuations in raw material prices.

Figure 10. Monoammonium phosphate, Ammonia, Phosphate Rock & Sulfur Prices, 2002-2016



Source: (1) Alberta Agricultural Input Monitoring System (AIMS), Alberta Agriculture and Forestry, Economics and Competitiveness Branch, Statistics and Data Development Section; (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

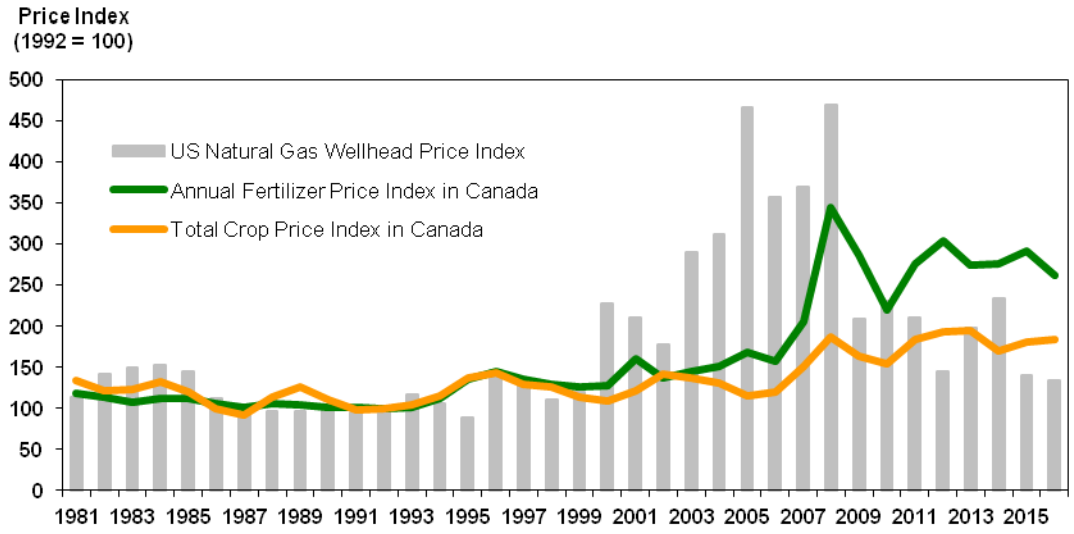
(3) Production Costs for Potash

Potash is primarily mined from underground ore deposits. Production costs for potash are generally affected by a mine's geology (such as ore thickness, consistency, continuity, depth and grade), energy and water management costs, the level of mill recovery, operational capacity, and the degree of automation.

Market Supply and Demand

As in the case of fuel, fertilizers are internationally traded commodities and their prices are determined by global supply and demand factors. Figure 11 shows how fertilizer prices responded to agricultural commodity prices in Canada.

Figure 11. Price Movement for Fertilizer, Crop and Natural Gas, 1981-2016



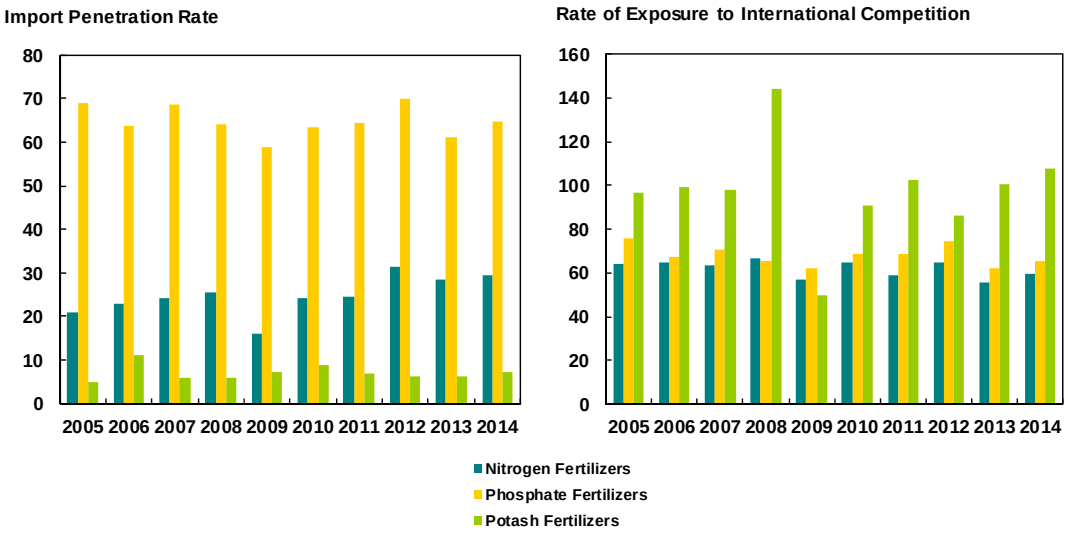
Sources: (1) Statistics Canada; (2) United States Energy Information Administration; (3) AAFC calculations.

The increase in the fertilizer price index occurred roughly at the same time the crop price index increased. For example, strong fertilizer demand, driven by high crop prices, kept fertilizer prices high despite low natural gas prices over 2011-2012. Therefore, although natural gas prices have declined, nitrogen prices can still move higher independently of the price of their natural gas feedstock when supply is unable to keep up with the demand for fertilizer. The graph supports the observation that fertilizer prices have been more tied to international demand and supply factors than to natural gas prices in recent years.

Competition

Canada is one of the world's major exporters of fertilizer, but also an important importer. In 2014, Canadian fertilizer exports represented more than three-quarters of its production while imports accounted for 35% of domestic fertilizer consumption. The largest portion of Canadian fertilizer exports are destined for the U.S. while most of the imports are also from the U.S. With increasing globalization and market liberalization, Canadian fertilizer production targeted at domestic markets experiences competition from imports. Meanwhile, Canadian fertilizer exports also face international competition in global markets. Figure 12 presents measures of exposure to foreign competition for the Canadian fertilizer industry over 2005-2014.

Figure 12. Measures of Exposure to Foreign Competition for the Canadian Fertilizer Industry



Sources: (1) Food and Agriculture Organization of the United Nations, FAOSTAT database; (2) AAFC calculations.

Import penetration rates[7] show the high magnitude of foreign competition faced by Canadian phosphate fertilizer producers within the domestic market. Meanwhile, Canadian nitrogen fertilizer producers confront relatively little foreign competition, and potash producers face almost no foreign competition as the domestic market is supplied almost exclusively by domestic production. When domestic and global markets are considered together, the rates of exposure to international competition[8] show that Canadian potash producers, with their high export orientation, are exposed to the highest level of foreign competition, followed by phosphate fertilizer producers.

Canadian fertilizer prices reflect a balancing of several factors. Given that there are foreign competitors within domestic and global markets, Canadian fertilizer suppliers have little choice but to match world market prices in order to establish market share. However, there are five countries (China, India, U.S., the Russian Federation, and Canada) that control 50-80% of the world production capacity for the major nitrogen, phosphate and potash fertilizers. Among the major producing countries, with the exception of China, there are four firms in each country that generally control more than half of production capacity. The high levels of

[7] Import penetration rate = import quantity in nutrients/consumption in nutrients*100.

[8] Rate of exposure to international competition = (export quantity in nutrients/production in nutrients + (1 – export quantity in nutrients/production in nutrients) * (import quantity in nutrients/consumption in nutrients))*100.

concentration in the industry may result in market power being exerted by dominant firms.[9]

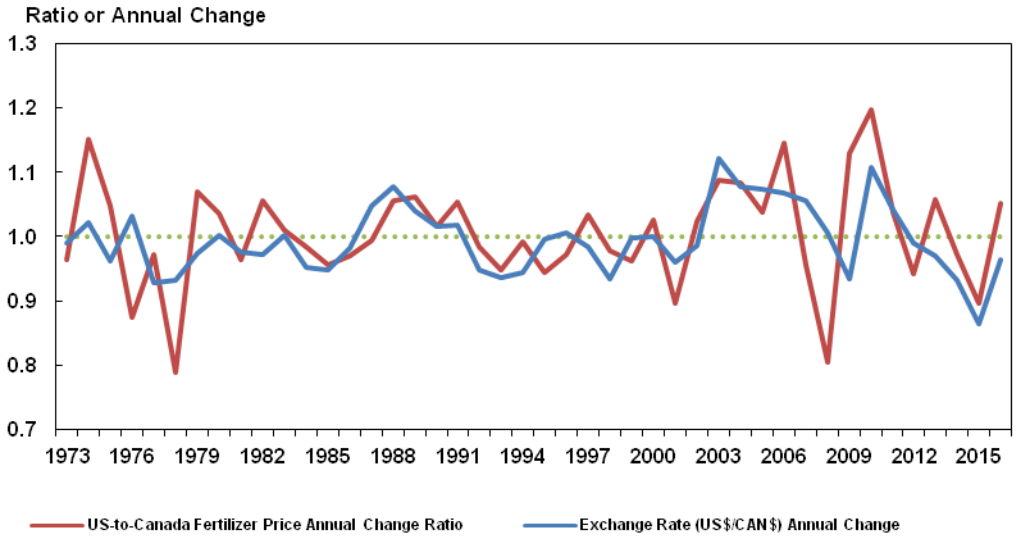
Other Factors

Exchange rates also have an effect on fertilizer pricing as Canadian fertilizer prices must either rise or decline to the level of import prices to remain competitive. The annual change in US-to-Canada fertilizer price ratio[10] shows what impact the exchange rate has on fertilizer prices in the U.S. and Canada. Figure 13 illustrates that Canadian fertilizer prices seem to reflect long-run movement in Canadian dollar exchange rates. It would appear that appreciation of the Canadian dollar has had a beneficial impact on fertilizer prices for Canadian farmers. For example, when the Canadian dollar appreciated over 2003-2006, Canadian farmers saw a relative advantage as fertilizer prices in Canada increased by only 9%, slower than in the U.S. (40%) during this period. Conversely, Canadian farmers saw a relative disadvantage compared to American producers when the Canadian dollar depreciated over 1977-1986, and Canadian fertilizer prices rose at a greater pace than in the US (53% in Canada versus 25% in U.S.).

[9] M. A. Hernandez & M. Torero, Market Concentration and Pricing Behavior in the Fertilizer Industry: A Global Approach, IFPRI.

[10] The annual change in US-to-Canada fertilizer price ratio = annual US fertilizer price change / annual Canadian fertilizer price change. When the exchange rate (US$/CAN$) increases, the annual change in US-to-Canada fertilizer price ratio should also rise, reflecting a US fertilizer price being translated into a lower Canadian fertilizer price in the domestic market, and vice versa.

Figure 13. US-to-Canada Fertilizer Price Annual Change Ratio & Exchange Rate Annual Change, 1973-2016



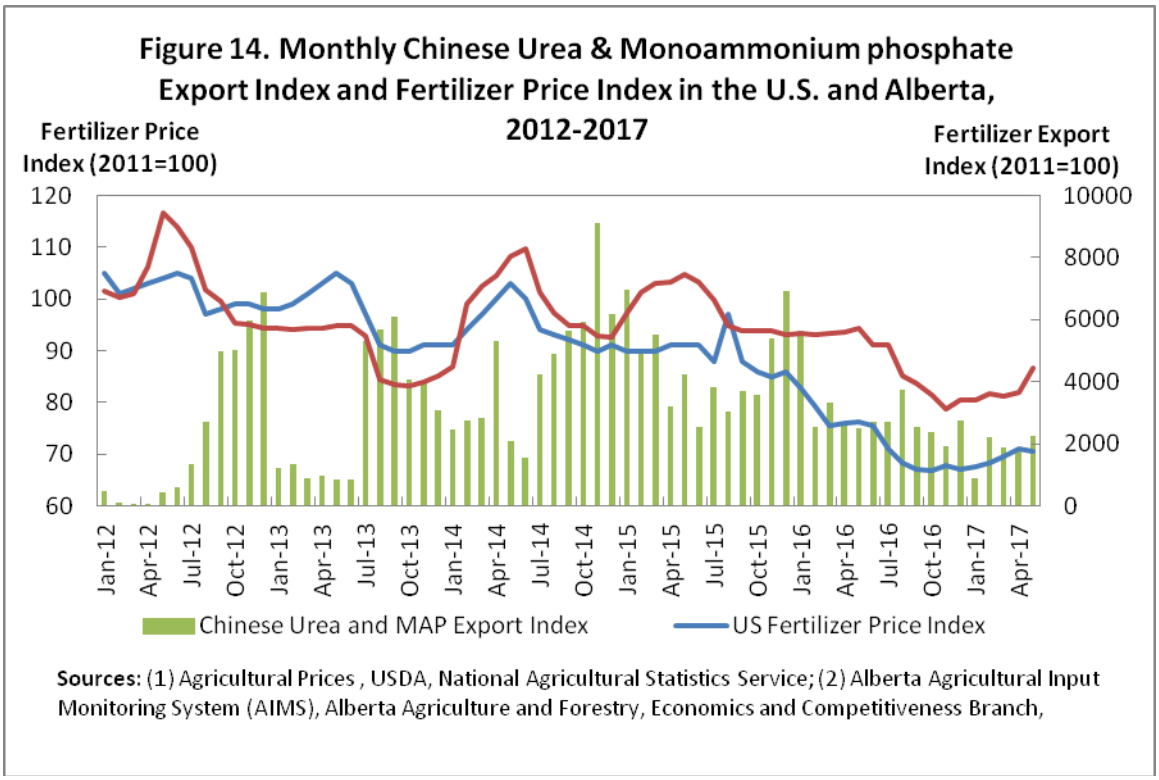
Sources: (1) USDA National Agricultural Statistics Service (NASS); (2) Statistics Canada; (3) AAFC calculations.

Besides exchange rates, government policies in major fertilizer exporting and importing countries can influence fertilizer prices in global markets. For example, China is the largest consumer and also a significant supplier of fertilizers. Unlike the rest of world, the primary feedstock for producing ammonia in China is coal instead of natural gas, which reflects China's resource endowments. China has only 1% of the world's proven natural gas reserves, but 14% of the world's coal reserves.[11] The Chinese government in the past had an export subsidy to encourage the fertilizer industry to increase its production capacity. However, the government canceled the fertilizer export subsidy after 2008 and applied an export tax to ensure an adequate supply for its domestic needs. Meanwhile, the export tax was reduced during the off season.[12] In 2015, the Chinese government stopped applying the high export tax in peak season and made the year-round export tax the same. In 2017, the government completely canceled the export tax for urea, monoammonium phosphate and diammonium phosphate fertilizers. Figure 14 shows that the structure of the Chinese export tariff resulted in huge swings in volumes sold offshore and volatility in global fertilizer prices between the low-tariff season and the high-tariff season over 2012-2014. The role of China as a major exporter of urea and phosphate fertilizers has been increasing in recent years, making China one of the most prominent players in determining prices globally.

[11] Toward Sustainable Use of Nitrogen Fertilizers in China, Giannini Foundation of Agricultural Economics, University of California.

[12] For urea, July 1 to October 31 was the off-season over 2011-2014. For phosphate, June 1 to September 30 was the off-season before 2013, while May 16 to October 15 was the off-season over 2013-2014.

Figure 14 also displays that Chinese fertilizer export started to decrease in 2016 and will likely continue to be low in 2017 as many anthracite coal-based fertilizer capacities were shut down or idled due mainly to higher production costs and environmental concerns. However, despite Chinese fertilizer export decreases, the fertilizer prices in the U.S. and Canada have been declining since 2016 as a result of new capacity additions that are taking place in the U.S.



FARM FERTILIZER USAGE

Using 1981-2016 annual historical data, the elasticity of fertilizer consumption with respect to the seeded area of major grain and oilseeds was estimated to be 1.33 in Canada. In other words, on average, a 1% increase in seeded area resulted in a 1.33% increase in fertilizer use. Given seeded areas for total crops and fertilizer-intensive crops as well as other factors, Canadian fertilizer usage was estimated to be slightly higher in 2017 compared to 2016.

FARM FERTILIZER EXPENSES

Farm fertilizer expenses include all costs associated with the purchase of fertilizer and lime, including application costs if they are included in the price paid by a farmer. In Canada, when price and usage changes were considered together, fertilizer expenses were estimated to be $4.6 billion in 2016, a decrease of 11% over 2015. Fertilizer expenses in 2017 are forecast to be $4.5 billion, a

decrease of 1.5% compared to 2016 and lower than the 2012-2016 average annual expense of $5.0 billion.

CONCLUSION

The price of fuel is generally determined by the forces of global supply and demand, and the agricultural sector is largely a price taker for both diesel and gasoline. Fuel prices dropped significantly in 2014 as Saudi Arabia was no longer willing to cut its oil production to support higher prices while global demand growth slowed and a U.S. shale oil boom increased supply. However, the supply and demand balances are slowly returning to a sustained equilibrium in 2017 as a result of the expected reductions in global oil supply and the rising global fuel demand supported by continued international economic improvement. Looking ahead, this should be supportive of fuel prices as we go into 2017.

As in the case of fuel, fertilizers are also internationally traded commodities and their prices are determined by global supply, demand and other factors. Over the years, low natural gas prices, high crop prices and perceived solid demand have led to investment in new fertilizer capacity including the construction of new plants, restarting closed plants, and possible expansion at existing facilities. As a result, a surge of new fertilizer capacity has started to come on-stream since 2016 and the fertilizer industry is expected to see excess capacities going forward. This supply and demand imbalance has been putting a downward pressure on the fertilizer prices. The fertilizer price declines have resulted in substantial cost reductions for Canadian farmers in 2016 and 2017.

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