



Canadian Fertilizer
Products Forum

Forum Canadien sur
les produits fertilisants

RESEARCH REPORT

EMERGING MARKET OPPORTUNITIES AND TRENDS

Prepared for the
Canadian Fertilizer
Products Forum





THE CANADIAN FERTILIZER PRODUCTS FORUM

The Canadian Fertilizer Products Forum (CFPF) was launched in the fall of 2006 to provide a forum for stakeholder input into the regulatory process for fertilizers and supplements. The CFPF brings together producer groups, industry representatives, non-governmental organizations and regulatory officials from across the country to provide recommendations to improve the regulatory system.

The CFPF recognizes that fertilizers and supplements are the most important crop input. Agricultural producers in Canada spend about \$3 billion on fertilizers and supplements per year, more than on pesticides, seeds, fuel, or any other crop inputs.

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Agriculture and Agri-Food Canada (AAFC) is pleased to participate in this project. AAFC is committed to working with industry partners to increase public awareness of the importance of the agriculture and agri-food industry to Canada. Opinions expressed in this document are those of the Canadian Fertilizer Products Forum and not necessarily those of AAFC.



TABLE OF CONTENTS

ACKNOWLEDGEMENTS	1
A List of Tables	3
1.1 Purpose and Objectives	6
1.2 Report Outline	7
LITERATURE REVIEW	8
2.1 Fertilizer and Supplement Requirements of Canadian Farmers.....	8
2.2 Opportunities from New Technologies	9
2.2.1 Enhanced Efficiency Fertilizers.....	9
2.2.2 Nanotechnology	11
2.2.3 Biotechnology.....	11
2.3 Market Opportunities	14
2.3.1 Agricultural Development for Food Production	14
2.3.2 Agricultural Development for Non-Food Production.....	16
3.1 Interview Questionnaire	19
3.2 Descriptive Statistics	19
INTERVIEW RESULTS	21
4.1 Customer Needs	21
4.2 Emerging Trends.....	23
4.2.1 Macronutrients	23
4.2.2 Micronutrients	24
4.2.3 Supplements.....	24
4.2.4 Challenges and Opportunities.....	25
4.3 New Technologies.....	25
4.4 Market Opportunities.....	28
4.4.1 Sectoral.....	28
4.4.2 Geographical	29
4.5 Key Success Factors	30
SUMMARY AND ANALYSIS OF EMERGING MARKETS AND TRENDS.....	32
5.1 Biofuels	32
Brazil.....	33
5.2 Food and Nutrition Security.....	34
Africa.....	34
Asia	34
5.3 Environmental Concerns.....	35
Asia.....	35
North America	36
5.4 Organic Agriculture	36
CONCLUSIONS	37
APPENDIX A: INTERVIEW QUESTIONNAIRE	41
Customer Needs	42
Trends.....	42
Market Opportunities.....	42
Key Success Factors.....	42
Further Information and Documentation.....	43
APPENDIX B: FERTILIZER PRICES IN THE UNITED STATES.....	44



A LIST OF TABLES

Table 2.1	Biotechnology Developments and their Potential Impact on the Fertilizer Industry.....	12
Table 2.2	Ethanol Production and Net Trade Projections (Million Gallons)	16
Table 2.3	Estimates of Biofuel Yields and Fertilizer Application Rates on Selected Crops.....	17
Table 3.1	Distribution of Fertilizer Industry Interviewees by Type.....	19
Table 3.2	Distribution of Fertilizer Industry Interviewees by Jurisdiction.....	20
Table 4.1	Key Areas of Focus	22
Table 4.2	Challenges and Opportunities Surrounding Emerging Trends.....	25
Table 4.3	Challenges and Opportunities Surrounding New Technologies.....	27

A LIST OF FIGURES

Figure 1.0	Structure of the Report	7
Figure 2.0	Global Micronutrient Deficiencies	16
Figure 5.1	Road Conditions in Brazil	33
Figure 5.2	Forecast of Fertilizer Production and Demand in China by 2010.....	35
Figure 5.3	Soils at Risk in Asia	35



EXECUTIVE SUMMARY

The purpose of this project was to identify and assess emerging domestic and international market opportunities and trends for the Canadian fertilizer and supplement industries. Understanding these opportunities will help the industries to maintain or improve their competitiveness and meet the needs of agricultural producers in Canada and around the world.

To gain knowledge of the opportunities and trends, a literature review was conducted to understand the requirements of Canadian farmers, the opportunities presented by new technologies, and the development of markets for food and non-food production. In addition, interviews with industry experts were completed to gain perceptions and opinions regarding potential market trends and opportunities. The interviews focused on the needs of users, emerging trends within the fertilizer and supplement industries, new technologies, market opportunities, and the roles of industry and government in taking advantage of the potential opportunities.

Over the next five years, world fertilizer demand is projected to grow steadily (Heffer, 2007). Global demand for the primary macronutrients (N,P,K) is expected to increase by 2.6% per year on average primarily due to growth in Asia and, to a lesser extent, Latin America (Heffer, 2007). Expert opinion suggests that the growth rate of demand for micronutrients is approximately double that of macronutrients (i.e. 4-5%). Nutrient deficiencies within soils are driving this growth. Anecdotal evidence indicates a trend toward greater use of supplements, primarily driven by concern for the environment and increases in organic production.

Overall, there appears to be four main drivers of growth for fertilizers and supplements: biofuels; food and nutrition security; environmental concerns; and organic production.

The movement towards biofuels is resulting in higher commodity prices and increased crop production thereby creating increased demand for fertilizers and supplements as a whole. Given the current high levels of corn production for ethanol use in the United States, growth in fertilizer demand is expected to be limited over the next five years. However, increasing levels of sugarcane and soybean production in Brazil represent an opportunity for Canada to increase exports of fertilizer and supplement products for these commodities. Furthermore, Indonesia and Malaysia are expected to expand the use of palm oils in biodiesel production, thus requiring increased fertilization and, particularly, an increase in the use of potash (IFA Task Force on Bioenergy, 2007).

Soils, largely in developing economies but also in developed nations, are suffering from nutrient deficiencies. These deficiencies cause problems in terms of food security (i.e., not enough food) and nutrition security (i.e., ensuring that diets contain sufficient nutrients). Fertilizers are essential for agricultural growth in Africa and governments have committed to increasing fertilizer use in order to improve agricultural productivity and end hunger. A progressive but slow increase in fertilizer use across the continent is expected. This market has significant long term potential, but distribution of product is a challenge.



Soil deficiencies in Asia are also limiting agricultural production. While phosphate consumption is stabilizing, requirements for nitrogen and potash will continue to grow. Sulphur is also emerging as an important nutrient, particularly in India. There is a very large market for micronutrients in Asia in response to soil deficiencies. Therefore, the key to increasing agricultural productivity in developing economies is balanced applications of nutrients.

Concern for the environment is another factor driving the use of fertilizers and supplements, particularly in Asia and North America. In Asia, there is a very large market for enhanced efficiency fertilizers to address environmental issues and respond to future environmental legislation. In North America, there are increasing opportunities for enhanced efficiency fertilizers, organic fertilizers and supplements, and “green products” in response to regulation and increasing demand for products which reduce environmental impacts. Environmental remediation also requires compost, organic fertilizers and potentially biosolids in order to restore organic matter.

Growth in organic food sales and organic agriculture within Canada and the United States is creating opportunities for compost, organic fertilizers and organic matter.

In order to take advantage of emerging opportunities, the industry needs to be willing to change and invest in research and development. As well, industry stakeholders need to be ready to anticipate new opportunities and respond with products that suit the needs of users. Entry into new markets is challenging and extensive market research is required for product introduction.

The role of government is to provide support including: investment, innovation, research and development, effective regulation, intellectual property rights protection, and export programs to help companies understand potential markets and establish relationships.

Overall, industry and government need to work together to capture new market opportunities.



INTRODUCTION

One of the objectives of the Canadian Fertilizer Products Forum (CFPF) is to create a forum for dialogue and to communicate information to both the industry and government. One of the gaps in information that was identified is with respect to emerging markets and opportunities for the Canadian fertilizer and supplement industries.

1.1 Purpose and Objectives

The purpose of this project was to identify and assess emerging domestic and international market opportunities and trends for the Canadian fertilizer and supplement industries. Understanding these opportunities will help the industries to maintain or improve their competitiveness¹ and meet the needs of agricultural producers in Canada and around the world.

The objectives of this project were to:

- ☀ Identify emerging domestic and international market opportunities for the fertilizer and supplement industries.
- ☀ Provide an analysis of the growth opportunities and emerging developments that exist.
 - Examples may include technologies such as nanotechnology and enhanced efficiency fertilizers.
 - Where possible, opportunities will be examined for the fertilizer (macronutrients² and micronutrients³) and supplement industries (inoculants, wetting agents, compost, biosolids, plant growth regulators).
- ☀ Identify potential roles of government and industry in order to realize the opportunities.

¹ Competitiveness is the sustained ability to profitably gain or maintain market share (Agri-food Competitiveness Task Force, 1990).

² Macronutrients are nutrients which are required in the largest amounts (kg/ha). Macronutrients can be further categorized into primary and secondary nutrients. There are three primary macronutrients (nitrogen, phosphorus, and potassium (potash)) and three secondary macronutrients (sulphur, magnesium and calcium). Source: (Motavalli et al., 1993).

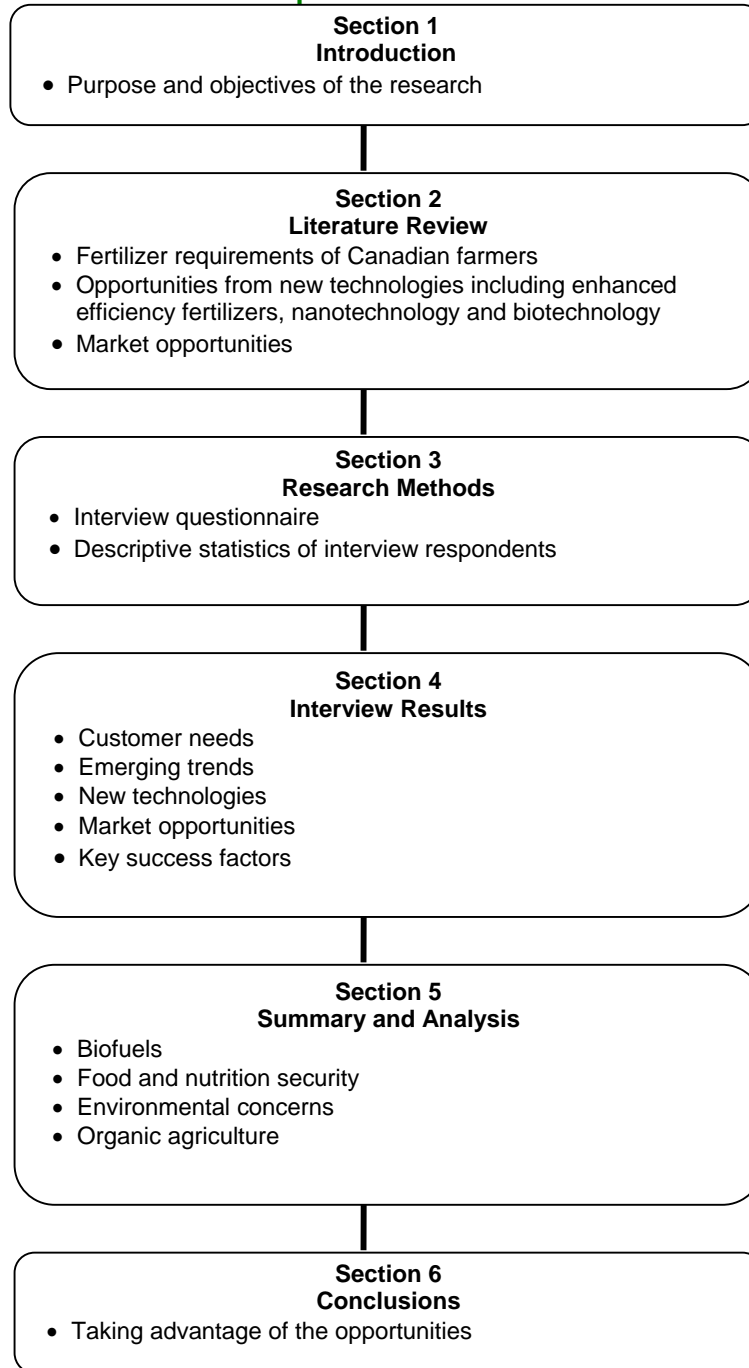
³ Micronutrients are nutrients that are needed in smaller quantities (g/ha). The micronutrients are: boron, chloride, copper, iron, manganese, molybdenum and zinc. Source: (Motavalli et al., 1993).



1.2 Report Outline

The document is organized as shown in Figure 1.0.

Figure 1.0 Structure of the Report





LITERATURE REVIEW

The purpose of the literature review is to develop a solid understanding of the needs of the industry and what is currently being described as emerging technologies and developments in the industry. Specifically, section 2.1 discusses domestic demand for fertilizer and supplements by farmers, section 2.2 reviews emerging technologies, while section 2.3 discusses the global market opportunities in both food and non-food production.

2.1 Fertilizer and Supplement Requirements of Canadian Farmers

In order to understand domestic demand for fertilizer and supplements in the future, it is interesting to explore the changing needs of users of these products. The following paragraphs focus on the fertilizer and supplement requirements of Canadian farmers.

Two surveys conducted by Ipsos Reid explore the fertilizer requirements of agricultural producers in Canada and provide information on the future growth potential within this market; one survey was performed in the fall of 2006 (Ipsos Reid, 2007b) and the other was conducted in the spring of 2007 (Ipsos Reid, 2007a).

The first of these surveys (fall 2006) addressed nitrogen application practices by 500 field crop producers across Canada.⁴ The survey found that the most commonly used form of nitrogen throughout the country is urea, with close to 6 out of 10 growers using it as their main nitrogen type. Approximately one-fifth of producers use anhydrous ammonia and one-tenth use urea ammonium nitrate (UAN).

Throughout the country, the majority of farms (81%) make one application of nitrogen per year with a much smaller proportion (13%) making split applications.⁵ Of those that apply split applications, most use different forms of nitrogen for each application. Interestingly, most producers in Western Canada (8 out of 10) use subsurface application, while most producers in Eastern Canada (7 out of 10) apply by surface broadcast. According to Ipsos Reid, the difference in application methods is somewhat attributable to the type of fertilizer (e.g. anhydrous ammonia, manure, etc.) and the crop to which it is being applied. Of those farmers that broadcast nitrogen, only about 4 out of 10 incorporate after application, although this varies by nitrogen type. Of those who incorporate after broadcasting, most (9 out of 10) incorporate within 24 hours of application (Ipsos Reid, 2007b). Application methods will be relevant when developing fertilizers for these regions because building on familiar techniques will allow for greater acceptability and uptake of new technology.

The second survey (spring 2007) focused on attitudes and usages of fertilizer and supplement products by 400 field crop producers across Canada. The survey found, not surprisingly, that the main reason for using fertilizers and supplements was to increase yields. Conversely, the main

⁴ Note that Atlantic Canada was not included as part of the survey.

⁵ Split application is the process of matching nitrogen supply for a pre-established target yield and a given level of soil moisture, and then supplying the remaining nitrogen as moisture conditions improve (Saskatchewan Soil Conservation Association, 2005).



reason for not using fertilizers and supplements was that they were either not needed or were not available. The main reason for using manure and compost was the fact that these products are readily available (Ipsos Reid, 2007a).

Approximately 9 out of 10 growers surveyed nationally apply fertilizers and/or supplements. The majority of producers do not plan to make a major change in their usage of various products.

Approximately 13% of current users of compost and potash intend to increase their use. 11% of current users of micronutrients plan to increase their use of the products. Usage of compost was favoured due to its soil improvement qualities (Ipsos Reid, 2007a).

Approximately 20% of current users of nitrogen plan to decrease use in the next three years. Similarly, 17% and 16% of current users of biosolids and phosphate, respectively, plan to decrease use. The least likely product to see a decrease in use was compost, with only 3% of users planning to decrease their use in the near future. The most common reason given for planning to decrease usage of most products was cost. However, for biosolids, the two primary reasons for declining use included environmental concerns and public perception. For manure and compost, the primary reason for decreasing usage was most often a decrease in the size of the operation (Ipsos Reid, 2007a).

The survey results suggest that among non-users of each product the largest increases in usage will occur in nitrogen and inoculant products. Approximately one quarter of non-users indicated they are likely to use these products in the next three years. In addition, approximately one fifth of non-users intend to use slow release fertilizers (Ipsos Reid, 2007a).

One fifth of Canadian farmers are aware of products that are not available in Canada. This awareness is most acute in Alberta and Saskatchewan where 31% of farmers know of products they cannot access. The products that are most sought-after by these farmers are nitrogen and phosphate products.

2.2 Opportunities from New Technologies

This section explores new technologies that are emerging within the agricultural industry, including enhanced efficiency fertilizers, nanotechnology and biotechnology.

2.2.1 Enhanced Efficiency Fertilizers

Enhanced efficiency fertilizers (EEFs) minimize the potential for nutrient losses to the environment (AgIndustries Research & Consulting Inc, 2007). There are two categories of EEFs:

1. Slow release and controlled release fertilizers
2. Stabilized nitrogen fertilizers

Slow release or controlled release fertilizers can be classified into three categories depending on the process by which the nutrients are released. Some are in pellet form (*pelletized*) and are slow release because it takes time for the pellet to break down by microbial action. Another form of slow release is *chemically altered* so that only a portion of the nutrient is water soluble leaving



the remaining portion to gradually break down by microbial action within the soil. The third form is a *coated* fertilizer. Water-soluble fertilizers are coated in a semi-permeable membrane. The water enters the capsule and the internal pressure disrupts the membrane, releasing the nutrients (Relf, 2007).⁶

Stabilized nitrogen fertilizers are fertilizers to which a nitrogen stabilizer has been added. The stabilizer (e.g. nitrification inhibitor, urease inhibitor) extends the time that the fertilizer's nitrogen component remains in the soil in the urea or ammoniacal form, thereby minimizing the potential for nutrient losses (AgIndustries Research & Consulting Inc, 2007).

Slow release or controlled release fertilizers have been available for some time within the specialized markets where their higher cost has been justified by the high value crops, e.g. lawn and garden/homeowner applications, golf courses, high value specialty crops (seasonal vegetables and fruits) (Hall, 2005). However, in recent years, new technology advances have resulted in enhanced efficiency fertilizers that are cost-effective and feasible for use on major agricultural crops (AgIndustries Research & Consulting Inc, 2007). This is of great importance for commodity crop producers due to the environmental benefits and application cost advantages (AgIndustries Research & Consulting Inc, 2007).

There are a number of drivers and motives that have contributed to the expanding market of enhanced efficiency fertilizers (AgIndustries Research & Consulting Inc, 2007; Hall, 2005):

- ☀ Technology - The products improve delivery of nutrients efficiently and safely.
- ☀ User needs - There is no crop burning. As well, the products allow for a reduction in labour required for nutrient application and the products improve the yield and quality of the crop.
- ☀ Economic incentives - Some jurisdictions have provided subsidies or encouraged usage of EEFs through beneficial management practices (BMPs). These incentives have been provided largely due to issues surrounding public relations and reducing liability.
- ☀ Regulatory/political - Public opinion and regulations have stipulated that agriculture and other fertilizer consuming industries need to reduce nutrient application and leaching, thereby contributing to the use of EEFs.
- ☀ Energy prices – Interest is growing in nitrogen use efficiency because higher energy prices have caused rapid increases in fertilizer prices.

Improving the efficiency of nutrient applications is very important to the development of the fertilizer industry. The enhanced efficiency technology provides a means to ensure plants and crops receive their required nutrients while also reducing the potential negative environmental impact of nutrient leaching into the water reservoirs of the world.

Extensive research by scientists on behalf of Agrium has indicated that slow release technology, such as Environmentally Smart Nitrogen (ESN), a controlled-release nitrogen, is an efficient and effective way to supply a crop with nitrogen. There are some areas for improvement of the product that were indicated by the research (Agrium, 2005). An increase in the durability of the product would likely enhance consistency of performance across the field. Developing a product

⁶ Note that for Environmentally Smart Nitrogen (ESN), the membrane is not disrupted.



that allows for slower release at lower temperatures (low temperature sensitivity) and reducing the rate of release at the front-end would increase the performance and consistency of the product (Agrium, 2005).

Aside from the most obvious benefits of enhanced efficiency fertilizers (i.e. greater nitrogen utilization, lower nutrient losses, lower labour requirements, and higher yields), Hall (2005) outlines some hidden benefits that are not often proclaimed. By increasing nitrogen fertilizer efficiency, there is a reduction in the nitrogen released into the atmosphere, thus reducing the contribution agriculture makes to air pollution. In addition, enhanced efficiency fertilizers reduce the stress placed on a growing plant and enhance growth consistency. These factors have often been correlated with reduced disease and higher quality of crops (Hall, 2005). Other indirect environmental (and economic) impacts from increased efficiency and concentrations of fertilizer are the reduction in transportation and fuel costs associated with distribution and application of the fertilizer (Hall, 2005).

The technological advances of enhanced efficiency fertilizers are achieving nutrient efficiencies and thus providing the environmental and economic benefits desired from the marketplace. However, to maintain these markets, the industry needs to collect records of these efficiencies and use them to promote the industry as a globally and environmentally responsible industry (West, 2007b). Hall (2005) also points out that consistency within the industry regarding claims of days of nutrient availability or timing of nutrient release should be addressed because the variability within the market has caused consumer confusion as to what they can and should be using.

2.2.2 Nanotechnology

Nanotechnology is a relatively new technology that provides the means to manipulate atoms and molecules directly. The technology combines fundamental science, materials science and engineering at the nanometre scale (this is a billionth of a metre) allowing structures the size of a molecule to be manufactured (Opara, 2004). Although nanotechnology is already in the marketplace (for example, in canola oil, anti-bacterial medical dressings, and stain-resistant fabrics) there are currently far fewer nanotechnology applications in the agri-food industry (Joseph and Morrison, 2006; Kuzma and VerHage, 2006).

Further development of nanotechnologies within agricultural production is expected to lead to plants that use inputs, including fertilizers, more efficiently. Scientists are working on nanotechnologies that make fertilizer delivery systems which respond to environmental changes as well as nanotechnologies that will create plant health monitoring systems. These technologies will increase the precision and efficiencies within agricultural production. Nanotechnology has been labelled as the new industrial, and consequently, agricultural, revolution (Joseph and Morrison, 2006; Kuzma and VerHage, 2006).

2.2.3 Biotechnology

Developments within plant biotechnology impact the fertilizer industry because as yields increase, the nutrients required for plant development can also change. For example, technologies that have led to increased disease and pest resistance have reduced stress on the plant and allow for greater nutrient uptake, thus increasing the need for fertilizer (Maene and Heffer, 2005). Table 2.1 gives a brief description of some biotechnology innovations that are currently in the pipeline and their expected influence on the fertilizer industry.



Table 2.1 Biotechnology Developments and their Potential Impact on the Fertilizer Industry

	Description of New Technology	Positive Impacts on Fertilizer Industry
Improved protein content	Increasing the protein content of corn/maize to lower soybean meal requirements in animal rations.	Expected to increase nitrogen use as more nitrogen will be removed from the soil to produce more protein.
Higher iron content	Micronutrient deficiencies, particularly iron, are a major global health concern. Researchers are enhancing the micronutrient uptake and storage in edible parts of staple foods to combat these human nutritional needs.	It is expected that these plants will remove more iron from the soil and therefore replacement of iron through fertilization will be required.
Functional foods and nutraceuticals	The development of foods with added nutritional value (e.g. higher vitamin content or modified fatty acids).	Nutritional requirements for these new plants will need fertilizer adaptation. Most likely, these varieties will need higher levels of potassium, secondary macronutrients and micronutrients.
Tolerance to drought and salinity	Example techniques to improve tolerance: inserting genes that will allow mannitol ⁷ production by the plant OR increasing the acquisition and storage of potassium as opposed to sodium.	Higher yields in dryer areas should equate to increased fertilizer use. Salt tolerant varieties will likely need more potassium fertilizer to fully express the new characteristic.
Aluminum tolerance	Approximately 40% of tropical soils are acidic due to aluminum toxicity as well as manganese toxicity and low phosphorus availability. Aluminum tolerant plants will increase yields on these soils.	Increased yields will increase the consumption of fertilizers on these tropical soils.
Improved energy efficiency of biofuel crops	Enabling corn/maize to produce its own amylase (enzyme used in biofuel production process) thereby increasing the efficiency of biofuel production.	Increased competitiveness of biofuels is expected to increase global crop production causing an increase in fertilizer demand.
Low lignin	Genetic modifications resulting in faster growing, low-lignin trees would greatly benefit the pulp and paper industry due to reduced energy requirements and waste from production.	Developments of faster growing trees will intensify forestry and therefore likely increase fertilizer requirements to compensate for higher nutrient exports resulting from the harvesting of faster growing trees.
C4 genes	Cereals are split into two groups depending on photosynthetic metabolism: C3 group (wheat, rice) and C4 group (corn, sorghum). C4 plants have significantly higher photosynthetic efficiency. Researchers are attempting to transfer C4 genes into rice and wheat to increase yield potential.	Increasing yield equates with increased nutrient requirements and therefore increased fertilizer demand.
Improved content of essential amino acids	Increase levels of lysine and methionine in corn/maize varieties. These two amino acids are limiting factors in low-protein diets. Increasing these amino acids will reduce protein requirements in animal rations.	Increased sulphur fertilizer as sulphur is removed for methionine production by the plant. A possible reduction in nitrogen use because there would be a reduction in protein requirements.

⁷ A white, crystalline, sweetish, water-soluble, carbohydrate alcohol, C₆H₈(OH)₆, commonly found in the manna of the ash and other plants: used in the manufacture of resins and plasticizers among other things. Definition taken from Random House Dictionary (1999).



Higher bio-available phosphorus content	Corn/maize that will produce its own phytase. ⁸ This will increase the amount of phosphorus available from the plant in livestock diets thereby reducing need to supplement livestock diets.	Although the fertilizer industry will likely see a market loss in supplying phosphates for feed, there may (over time) be an increase in the demand for phosphorus fertilizers because manure will contain less phosphorus.
	Description of New Technology	Negative Impacts on Fertilizer Industry
Improved uptake and metabolism of nutrients	Identifying genes that improve metabolism and nutrient uptake and using genetic markers to breed for these traits.	Negative impact on fertilizer industry because increased plant uptake and metabolism efficiency means fewer nutrients will be required for the same yield.
Phytase excreting plants	Phytase is an enzyme that breaks down phytate into phosphorus that is available for plant uptake. A lot of organic soil phosphorus is in the form of phytate which is largely unavailable to plants. By ensuring that phytase is excreted by the plants, phosphorus becomes available for plant uptake.	Initially, this technological development will negatively impact phosphorus fertilizer consumption. However, usage should stabilize at an appropriate level for compensating phosphorus removals.
	Description of New Technology	No Impacts on Fertilizer Industry
Genetic control of heavy metals uptake and/or tolerance	Decreasing uptake of heavy metals by food crops and increasing tolerance and uptake for non-food plants allowing for increased bioremediation ⁹ .	Little impact on overall consumption of fertilizers. However, this technology could allow for certain sources of fertilizers to be allowed despite above average contents of heavy metals.

Source: (Maene and Heffer, 2005)

Developments of plants and their symbiotic relationships with micro-organisms are also occurring within the biotechnology field and could have both positive and negative impacts on the fertilizer and supplement industries. However, the potential negative impact has been downplayed by Maene and Heffer (2005) who suggest that many of these technologies will only have a temporary dampening effect on the industry, or that the development of some traits are so far in the future that it is not reasonable to consider them a threat.

One such innovation, already in use in Western Canada and on some Northern US soils, is a phosphorus-solubilizing fungus. This fungus stimulates phosphorus uptake and although it is expected to have some negative effects on the consumption of phosphorus fertilizer, once the stock within the soil is exhausted, it is expected phosphorus will continue be needed to replenish the soil.

Some microorganism-plant symbiosis developments are still in the early research stages, such as sulphur-oxidizing bacteria. Many people wish to see higher analysis sulphur fertilizers; however, elemental sulphur is not readily available to plants. To solve this, researchers have isolated a sulphur-oxidizing bacterium which oxidizes elemental sulphur thus making it available to plants. Commercialization of this bacterium will positively impact the consumption of sulphur fertilizers.

Alternatively, a separate development that might have a negative impact on the consumption of nitrogen fertilizer is the attempt to transfer the nitrogen-fixing ability of legumes to cereals, such as wheat. This trait is unlikely to be available in cereals before 2020. However, this development

⁸ An enzyme that breaks down phytate and releases phosphorus.

⁹ Use of plants to remove toxins from the soil.



could have a significant impact on nitrogen fertilizer consumption because nitrogen fertilizers would no longer be required in crops that traditionally are high users of nitrogen (Maene and Heffer, 2005).

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) in Australia recently illustrated that there are numerous microbes in Australian soils that are non-symbiotic¹⁰ nitrogen fixers. Unlike symbiotic nitrogen fixers, non-symbiotic nitrogen fixing bacteria must find their own energy source to convert nitrogen gas to ammonia. These bacteria are capable of fixing significant atmospheric nitrogen in the absence of legumes, using crop residues as an energy source (Vadakattu and Paterson, 2006). Development of such microbes could lead to more targeted nitrogen fertilizer use and increased use of such microbes as soil inoculants.

2.3 Market Opportunities

Taking a big picture view, the markets for fertilizer are expected to continue to grow due to the unavoidable fact that world population continues to increase. The global population is expected to reach 8.2 billion in 2030, increasing from 6.2 billion in 2000. Not only are population levels rising but the amount of food (calories) that each individual consumes daily is also expected to grow by approximately 9% (IFA, 2007). Increased crop production to meet food, feed and fuel requirements of the growing population needs to be supplied from land suitable for agriculture, which is a limited resource. The area available for agricultural production is limited therefore yields must increase. The challenge is to do this without jeopardizing the environment (IFA, 2007). Technologies that increase the efficiency of fertilizers and reduce any negative environmental impacts are bound to have significant markets internationally. The following sections outline market opportunities for agricultural development for food and non-food production and the implications for fertilizer.

2.3.1 Agricultural Development for Food Production

Africa

Africa is expected to increase fertilizer usage. Soil infertility is an issue across much of the African continent and, in an agricultural society, soil infertility equates with poverty. In an attempt to eradicate global poverty the renowned economist, Jeffery Sachs, has developed a program call “Millennium Village.” The program allocates US\$110 per person per year, for a period of five years, to implement a prescribed set of basic interventions, one of which is fertilizer and high-yield seeds¹¹ (Munk, 2007). In addition, in 2006 the African Union Ministers of Agriculture declared that “fertilizer was a strategic commodity without borders.” It was resolved that in order to develop African agriculture and end hunger, fertilizer use should be increased from the current average of 7 pounds per acre to an average of at least 45 pounds per acre by 2015 (West, 2007a). A fertilizer policy toolkit has been developed through a collaborative project between the World Bank, UK Department of International Development, and US Agency for International Development. This toolkit helps decision makers initiate policies that will increase the use of fertilizer in African nations (World Bank, 2006).

¹⁰ In other words, not parasitic on another organism.

¹¹ Other interventions include clean water, rudimentary health care, basic education, mosquito bed nets, and a communication link to the outside world.



While change since the 2006 resolution has been limited, some countries are considering tariff revisions and the introduction of fertilizer subsidies (Heffer, 2007). As an example, the Malawi government implemented a fertilizer subsidy in 2005/2006 that has been hailed a success despite some criticisms (Dugger, 2007). The subsidy was targeted at resource constrained but productive corn farmers, specifically farmers who had the resources to use the fertilizer productively but would otherwise have difficulty obtaining it (Chinsinga, 2007). Access to subsidized fertilizer was on the basis of coupons (Chinsinga, 2007). Overall, 147,000 metric tonnes of fertilizer were distributed to tobacco and corn farmers throughout the country (Chinsinga, 2007).¹² The private sector was included in the procurement of fertilizer but not in the distribution. From an agronomic perspective, it is estimated that the program had a positive impact on corn production estimated in the range of 15-22% of total production and a positive impact on the livelihoods of people (Doward et al., 2007 as cited in Chinsinga, 2007). However, the subsidy program was blamed for closures within the agro-dealer network. It is estimated that 60-70% of retail outlets closed with a large proportion of the staff being laid off as a result of reduced retail sales during the 2005/2006 growing season (Chinsinga, 2007).

Overall, it is expected that encouragement and support from governments and development organizations will contribute to a progressive but slow increase in fertilizer use across the African continent.

Asia

Growing deficiencies in macronutrients and micronutrients within Asia are creating a need for fertilizers. These deficiencies have a direct impact on crop and human well-being. Many deficiencies can be effectively supplied through fertilization.

In India, growing nutrient deficiencies are considered an issue. Micronutrient deficiencies have been reported as one of the main causes for yield stagnation or reduction, especially in irrigated intensified systems (Takkar et al., 1989 as cited in Rego et al., 2007). For example, in the irrigated, fertile Indo-Gangetic plains, the deficiencies of secondary nutrients such as sulphur and micronutrients, especially zinc, are known as constraints to crop production and productivity (Takkar, 1996; Katyal and Rattan, 2003 as cited in Rego et al., 2007). Recent research also shows widespread deficiencies of sulphur, boron and zinc in dryland agricultural conditions (Rego et al., 2007).

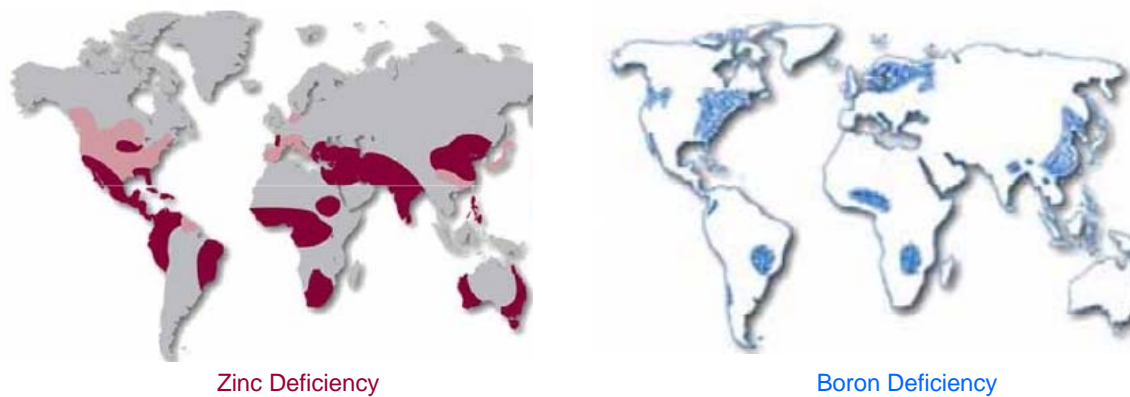
In China, unbalanced use of fertilizers (e.g. too much nitrogen versus potash) and deficiencies in secondary macronutrients and micronutrients are restricting agricultural productivity (Heffer, 2007).

As an example, Figure 2.0 provides a visual illustration of the presence of global micronutrient deficiencies. The presence of zinc and boron deficiencies in Asia is quite evident.

¹² It is noted that tobacco farmers were largely included in the program for political reasons (Chinsinga, 2007).



Figure 2.0 Global Micronutrient Deficiencies



Source: (Shriram, 2007).

2.3.2 Agricultural Development for Non-Food Production

Biofuels

The increased use of crops for biofuels around the globe is an area for growth for the fertilizer industry. In 2005, 37 billion litres of biofuel were produced from 14 million hectares of land around the world. Eighty-five percent of this production was ethanol and 15% was biodiesel. Production of biofuels has been growing at an average of 15% per year and this trend is expected to continue in the near future (IFA Task Force on Bioenergy, 2007). The 2007 Agricultural Outlook published by the Food and Agricultural Policy Research Institute (FAPRI) outlines expected production and trade of ethanol in the future (Table 2.2). The vast majority of this production is expected to be from corn and by 2016, only 5.5% of US production is expected to be from cellulose¹³ (FAPRI, 2007). Not surprisingly, Brazil will continue to be a key supplier and exporter of ethanol. Unfortunately, data for Canada is not available within this dataset.

Table 2.2 Ethanol Production and Net Trade Projections (Million Gallons)

Country/region	Production			Net trade*		
	2006	2011	2016	2006	2011	2016
United States	4,856	12,323	12,595	-679	-300	-327
Brazil	4,763	5,922	7,524	928	940	1,255
EU-25	864	1,157	1,458	-71	-182	-244
China	1,083	1,146	1,214	42	-52	-133
India	486	520	569	-118	-171	-195
Japan + Rep. Of Korea				-246	-411	-469
Rest of the World				23	1	-33

Source: FAPRI, 2007 as cited by (IFA Task Force on Bioenergy, 2007).

* Production minus consumption

¹³ E.g. crop waste, trees or grasses.



The International Fertilizer Industry Association (IFA) anticipates the continued development of the biofuel sector to be positive for the consumption of fertilizers globally. According to the FAPRI model, ethanol from corn will reach maximum capacity around 2010 suggesting that the demand for corn, and therefore fertilizer will continue to [0]increase for the next 4-5 years (IFA Task Force on Bioenergy, 2007). This trend of increased fertilizer demand is expected to be very similar in Canada.

Demand for fertilizer due to biofuel production is expected to increase in Brazil, the EU, Indonesia and Malaysia. Although all of these countries are producing biofuels, they are focused on using different crops as feedstocks, thus their fertilizer needs will be different. Table 2.3 provides an estimation of fertilizer application rates at particular biofuel yields for various crops around the world. Brazil's biofuel production is predominantly from sugar cane (for ethanol) and soybeans for biodiesel. The EU is expected to continue producing large amounts of rapeseed for biodiesel. Indonesia and Malaysia are expected to expand the use of palm oils in biodiesel production, thus requiring increased fertilization and, particularly, an increase in potash (IFA Task Force on Bioenergy, 2007).

Table 2.3 Estimates of Biofuel Yields and Fertilizer Application Rates on Selected Crops

Crop	Country	Biofuel Yield kg/ha ¹⁴	Fertilizer application rates ¹⁵		
			kg nutrient/ha		
			Nitrogen (N)	Phosphate (P ₂ O ₅)	Potash (K ₂ O)
Oil Palm FFB ¹⁶	Malaysia	4725	100	45	205
Sugar Cane	Brazil	3819	55	51	110
Maize	US	2361	132	47	54
Rapeseed	Germany	1534	170	45	90
Soybean	Brazil	524	8	66	62

Source: (IFA Task Force on Bioenergy, 2007).

Related to the continued development of the biofuel industry, the IFA expects that prices for cereals, oilseeds, and sugar will remain strong. Higher prices tend to encourage increased usage of fertilizer in order to extract higher yields; thus strong global commodity prices are also positive for the fertilizer industry (IFA Task Force on Bioenergy, 2007).

The IFA does note that the biofuel industry could be dampened if there is a global food crisis in the medium term; a crisis will call into question the use of land for biofuels rather than food production. However, as technology develops, it will likely allow for the production of biofuels from non-food crops and on land not suitable for intensive agriculture. These developments are

¹⁴ Crop yields from FAOSTAT. Means 2003 to 2005. The biofuel yields are in terms of relative energy content.

¹⁵ Fertilizer application rates: Fertilizer Use by Crop. 5th Edition. FAO, IFA, IFDC, IPI, PPI. Rome 2002. These data relate to around year 2000. Brazil: *Fertilizer use by crop in Brazil*, FAO, 2004. USA: Fixen (2007) as cited by (IFA Task Force on Bioenergy, 2007).

¹⁶ FFB = Fresh fruit bunch. Estate yields.



likely to open new regions of the world where fertilizer will be required; however, significant investment in research is required to ensure the environmental consequences from these new uses are not negative (IFA Task Force on Bioenergy, 2007).

Feed

A recent report by the Australian Farm Institute and the Rural Industries Research and Development Corporation indicates that there will be significant increases in animal protein demand in developing economies, particularly in Asia (Austin, 2007). Demand is based on population growth rates, increasing wealth and changing diets. The research investigated trends in twelve Asian nations¹⁷ and the results forecast that demand in these countries will increase by 30-50% by 2020, translating into increased import demands of 5.2 million metric tonnes of dairy products, 1.9 million metric tonnes of beef, 1.2 million metric tonnes of pork and 1 million metric tonnes of chicken (Austin, 2007). The fact that animals are fattened on feed grains which require fertilizers for production means that it is very likely there will be increased demand for fertilizer from increased meat consumption (Donville, 2007; Heffer, 2007).

Inoculants may also become increasingly important as producers and animal nutritionists look for increased performance from animals. Inoculants have been developed and used in various types of silage (e.g. corn, hay, etc.) and have shown to improve animal performance and result in improved dry matter recovery (Bagg, 2003).

¹⁷ The 12 countries studied included China, Japan, South Korea, India, Indonesia, Thailand, Pakistan, Bangladesh, Sri Lanka, the Philippines, Vietnam and Malaysia. Source: (Stewart, 2007).



RESEARCH METHODS

The purpose of this section of the report is to explain the research methods used by the George Morris Centre research team to complete the objectives of the study. Section 3.1 discusses the interview process that was used to identify emerging markets and opportunities for the Canadian fertilizer and supplement industries.

3.1 Interview Questionnaire

A formatted questionnaire was developed for use during the consultative/interview process to ensure consistency of information collection (refer to [Appendix A](#) for the questionnaire).

Types of information collected during the interviews included:

- ☀ Description of the changing needs of users of fertilizers and supplements
- ☀ Description of trends in the macronutrient, micronutrient and supplement industries
- ☀ Challenges and opportunities associated with new technologies
- ☀ Potential alternative markets (sectoral or geographical)
- ☀ Current industry requirements to take advantage of the opportunities
- ☀ Potential role of the public sector in helping stakeholders enter markets and realize opportunities

3.2 Descriptive Statistics

The research team completed 12 interviews with domestic and international stakeholders and experts.

It must be noted that there was no intention of conducting a survey with any statistical significance. The purpose of the surveys was to gain perceptions and opinions from a variety of industry stakeholders regarding potential market trends and opportunities.

The distribution of interview respondents by type and jurisdiction is illustrated in Table 3.1 and Table 3.2 respectively.

Table 3.1 Distribution of Fertilizer Industry Interviewees by Type

Interviewee Type	Total Number Interviewed
Industry Association	4
Public Sector	3
Private Sector	5



Table 3.2 Distribution of Fertilizer Industry Interviewees by Jurisdiction

Jurisdiction	Total Number Interviewed
Canada	7 ¹⁸
United States	2
International	3

It is important to note that of the 12 respondents, 2 interviewees were primarily involved in compost, 2 were primarily involved in inoculants, 1 was primarily involved in biosolids and 1 had in-depth knowledge of micronutrients.

¹⁸ It is worth noting that one respondent, while based in Canada, provided comments solely from an Asian perspective.



INTERVIEW RESULTS

The purpose of this section of the report is to present the results of the interviews with stakeholders regarding emerging markets and opportunities for the fertilizer and supplement industries.

The interview questions were organized around five themes: customer needs (section 4.1); emerging trends (section 4.2); new technologies (section 4.3); market opportunities (section 4.4); and key success factors (section 4.5).

4.1 Customer Needs

There are several key areas where the fertilizer and supplement industries need to focus attention in order to address customer needs in the future. Table 4.1 describes the primary areas of focus and the implications for the fertilizer and supplement industries. The respondents felt that the environment, renewable energy, and soil health were key concerns for users in the future.

Organic farming and retail sales of organic food were also identified as important for consumers. Certified organic farms have started to use organic fertilizers and dehydrated manure in order to improve and maintain soil health. One challenge for the fertilizer and supplement industries is that the organic certification process takes time and effort. In addition, the industry must work to ensure sufficient supply of products. The organic market represents an opportunity for increased demand for composts and organic matter.

As well, two respondents mentioned that fertilizers and supplements tailored to specific crops will be important for users in the future. One of these respondents felt that by matching nutrients and organic matter to the needs of the particular crop, performance could be improved. The other respondent mentioned that products with additional features in terms of nutrient elements, health elements and physical/chemical features could also be more prominent in the future.

Other factors that were thought to influence fertilizer requirements included commodity prices, quality of products, cost of fertilizers and supplements, food security, soil and tissue analysis, more balanced applications, precision farming techniques, and GDP growth, particularly in developing countries.



Table 4.1 Key Areas of Focus

Major Area of Focus	Drivers	Potential Implications	Industry Challenges	Industry Opportunities	Industry Requirements
Environment	<ul style="list-style-type: none"> Climate change, particularly changes in precipitation and temperature 	<ul style="list-style-type: none"> Increased environmental regulation Concern about environmental impacts (e.g. water quality) Increased desire for green products 	<ul style="list-style-type: none"> Synthetic fertilizers are derived from fossil fuels and generate greenhouse gases. Increased regulation (controlling/banning) of nutrients due to pollution Desire to reduce nutrient use 	<ul style="list-style-type: none"> In Asia, there may be a large market for enhanced efficiency fertilizers due to increased concern for the environment and greater environmental regulation in the future Increased focus on biological products that enhance environment 	<ul style="list-style-type: none"> Emphasis on enhanced efficiency fertilizers Focus on green and innovative products
Renewable Energy (e.g. biofuels and anaerobic digesters)	<ul style="list-style-type: none"> Concern for the environment Government policy Energy security 	<ul style="list-style-type: none"> Increased crop production and prices Ecological intensification Additional sources of nutrients (e.g. from digesters and biofuel production) 	<ul style="list-style-type: none"> Alternative feedstocks such as cellulose which may require lower levels of fertilization 	<ul style="list-style-type: none"> Increased demand for fertilizer 	<ul style="list-style-type: none"> Consideration of how alternative sources of nutrients may affect the industry
Soil Health	<ul style="list-style-type: none"> Concern about organic matter and soil health Nutrient deficiencies leading to low agricultural productivity and food and nutrition security issues 	<ul style="list-style-type: none"> Desire to replenish organic matter More balanced applications Desire to address soil deficiencies to improve human well-being 	<ul style="list-style-type: none"> Ability to satisfy demand (i.e. sufficient supply) Regulatory system needs improvement in order to ensure that innovative products, such as biological products, are available in the market Ability to enter new markets 	<ul style="list-style-type: none"> Greater focus on compost and other supplements to replenish organic matter Increased use of micronutrients Increased use of sulphur due to deficiencies in soils (largely in developed countries but also in developing regions) More potash and micronutrients required in Asia 	<ul style="list-style-type: none"> Greater emphasis on micronutrients in future Emphasis on balanced applications



4.2 Emerging Trends

Building on customer needs, this section examines emerging trends in macronutrients, micronutrients and supplements as well as the challenges and opportunities presented by these trends.

4.2.1 Macronutrients

Overall, respondents felt that there were reasons to expect increasing use of macronutrients in the future primarily due to the growth of the biofuels industry and Asian markets.

According to one respondent, global fertilizer consumption is expected to grow by 2-2.5% per year over the next 5 to 10 years. Growth of potash consumption is expected to be highest at 3-3.5% per year. It is estimated that 70% of total growth will occur in Asia and that 20% is attributable to biofuels, particularly in North America, Latin America and Western Europe. The growth of biofuels in Western Europe is counterbalancing the downward trend in fertilizer demand in the region, thus stabilizing consumption. A similar situation exists in North America where, without the influence of biofuels, there would likely be a decline in fertilizer usage. Note that these statistics are similar to those predicted in the medium term outlook paper published by the International Fertilizer Industry Association in 2007 (Heffer, 2007). Another respondent felt that increases in demand for macronutrients globally would have a positive effect on Canada since Canada is a significant producer and exporter of fertilizer.

One respondent familiar with the Asian market stated that nitrogen consumption is expected to grow while phosphate consumption is stabilizing. Potash requirements will continue to grow and represent a large opportunity. Sulphur is also emerging as an important nutrient in Asia and there are opportunities in calcium as well. According to the respondent, almost 50% of land in India is sulphur deficient and therefore development of this market is possible. There is a lot of opportunity for elemental products to be sold in Asia because of the acidic soils.

Given the high cost of nitrogen, one interviewee felt that the use of precision farming techniques would allow for more precise application and cost savings. In addition, the respondent felt that increasing the use of legumes in crop rotations to reduce nitrogen requirements was also a possibility.

One respondent felt that, in the future, there would be more multi-nutrient products than single nutrient products (e.g. adding micronutrients to macronutrient products).

Two respondents mentioned that sulphur is an important nutrient for canola in Western Canada.

Finally, one respondent raised the issue of recycling nutrients through the use of technologies such as anaerobic digesters.¹⁹ The respondent felt that these technologies could either reduce the need for synthetic fertilizers or potentially be used in conjunction with synthetic fertilizers.

¹⁹ Anaerobic digestion is the process of micro-organisms breaking down organic materials in the absence of oxygen in an enclosed vessel. Anaerobic digestion produces biogas (consisting primarily of methane and carbon dioxide) which can then be combusted to produce heat or electricity. Source: (DeBruyn and Hilborn, 2007).



4.2.2 Micronutrients

While figures on the future demand for micronutrients are difficult to attain, one respondent stated that it is estimated that the growth rate of demand for micronutrients is approximately double that of macronutrients (i.e. 4-5%). The demand for micronutrients is driven by deficiencies within the soil and this problem is expected to persist and potentially worsen.

Two respondents stated that nutrition security is a key driver of the demand for micronutrients. Nutrition security is ensuring that humans receive the nutrients that they require. To ensure that diets are sufficient in micronutrients, nutrient content in grains can be enhanced by increasing micronutrients within the soil. Therefore, micronutrient fertilizer products play an important role in ensuring nutrition security.

In India, there is a very large market for micronutrients such as zinc, boron and manganese. In Asia, production levels are limited by a lack of micronutrients. One respondent mentioned that China's demand for micronutrients will put significant pressure on the entire global market. One respondent described trends in the application of micronutrients. The respondent mentioned foliar application of micronutrients as one technique, but also sees potential for growth in seed treatment of micronutrients, a very efficient method of delivering micronutrients. In addition, the respondent stated that coating micronutrients onto granular fertilizers was also another recent trend.

4.2.3 Supplements

Concern about the environment and the increasing amount of organic agriculture is driving the use of some supplements, particularly compost. Two respondents felt that compost was becoming more and more popular; one of these respondents gave an example of how some golf courses in their region were switching to compost for its environmental benefits.

An interesting suggestion was related to the potential use of macronutrients in combination with supplements such as compost. The respondent felt that a pelletized fertilizer/compost combination could offer significant benefits, particularly in areas lacking organic matter.

One respondent felt that the emerging trend towards greater nutrient recycling could potentially increase the demand for supplements.

Another respondent mentioned that there will be a lot of biological products coming into the market, particularly plant growth regulators.

Two respondents mentioned growth in inoculants as part of the outlook for the future. One of these respondents felt that there would be growth not only in products with *Rhizobium* bacteria but also *Bacillus* bacteria and *Pseudomonas* bacteria.

In terms of biosolids, the respondent familiar with these products mentioned several trends. First, municipalities are moving toward dewatered products due to the high costs of transportation. Second, further treatment processes (e.g., addition of lime or alkaline materials or pelletization) are being used to reduce pathogens and create "pathogen-free" material. Further treatment implies a more saleable product and improves public perceptions surrounding biosolids. The respondent mentioned that new markets such as uses in landscaping and forestry may be created



given reductions in pathogens. In addition, the respondent felt that there is an opportunity for the use of biosolids in land reclamation (e.g. gravel pits, quarries and mines). In particular, the respondent felt that large areas of mine tailings in Northern Ontario could be reclaimed through the use of biosolids. Another relatively recent trend (3-4 years old) within the biosolids industry is the use of a compound called struvite. Struvite is magnesium ammonium phosphate (MAP) and is commonly found in wastewater treatment plants that have anaerobic digesters. If removed, struvite can be used as a fertilizer product. However, struvite extraction requires a retrofit of the sewage treatment plant and causes the remaining biosolids to be of lower value. Finally, the respondent stated that there may be a market for pelletized biosolids as filler in commercial fertilizers.

4.2.4 Challenges and Opportunities

The challenges and opportunities for fertilizer and supplement suppliers associated with the emerging trends identified above are outlined in Table 4.2.

Table 4.2 Challenges and Opportunities Surrounding Emerging Trends

	Challenges	Opportunities
Macronutrients	<ul style="list-style-type: none"> To produce sufficient supply for food, feed and fuel uses Surface and groundwater protection Maintaining or decreasing greenhouse gas emissions Ensure that there is not over production of macronutrients as other countries (e.g. Argentina, China) increase supply Lack of understanding of the reasons for fertilizer use in home and garden settings Regulations for handling and supplying ammonium nitrate and ammonia 	<ul style="list-style-type: none"> Farmers will have greater access to new products Opportunities for growth due to Asian markets and biofuels. Enhanced efficiency fertilizers
Micronutrients	<ul style="list-style-type: none"> Lack of understanding regarding the importance or necessity of micronutrients²⁰ Lack of supply Poor quality Potential heavy metal contamination if poor quality or improper application Regulatory system in Canada 	<ul style="list-style-type: none"> There is a very large market for micronutrients emerging in Asia Different application techniques
Supplements	<ul style="list-style-type: none"> With respect to the increasing use of compost and organic fertilizers, one of the primary challenges is the transition to organic agriculture (i.e., time and effort required for certification) Increase in organic production poses a threat to synthetic fertilizer manufacturers Some markets (e.g., EU and Japan) have specifications which may be difficult for Canadian compost and organic fertilizers to meet The Canadian regulatory system is a barrier 	<ul style="list-style-type: none"> Supplements, particularly compost, may have greater sales due to organic production Supplements may be positively affected by trend toward greater recycling of nutrients “Pathogen free” biosolids offer the potential to enter new markets such as landscaping, land

²⁰ The respondent suggested that the micronutrient industry needs to provide additional information (i.e. user-friendly literature) to potential users.



	Challenges	Opportunities
	<p>to the introduction of new products</p> <ul style="list-style-type: none"> • Having sufficient supply for organic markets (e.g., the Canadian fertilizer and supplement industries are not ready to do a massive conversion to organic) • Transitioning from laboratory to commercial production of products • Public perceptions surrounding biosolids • High costs associated with transportation of biosolids 	<p>reclamation and forestry</p>

4.3 New Technologies

Overall, respondents agreed that new technologies will create large opportunities for the fertilizer and supplement industries. One area of focus for many respondents was on more sustained/tailored plant nutrition. For example, one respondent felt that the use of plant signals to

develop fertilizer and supplement products that were able to sense the needs of the crop was a necessary development for the future. In this case, the products would supply nutrients only when the plants needed it. Similarly, another respondent mentioned that the focus needs to be on bio-availability and determining plant needs and matching fertilizers and supplements appropriately. Several respondents mentioned enhanced efficiency fertilizers and the opportunities that exist within those products, particularly in relation to high value crops.

Precision farming techniques were also mentioned as a new technology which improves the application of fertilizers. As well, improvement in information technology will enhance farmers' ability to record inputs and yields.

Two respondents discussed technologies related to the environment. One respondent felt that bio-fertilizers, bio-herbicides and bio-fungicides would likely come to market if improvements in the regulatory system were made. The other respondent felt that new "green" products aimed at reducing environmental impacts should be a key area of focus for the fertilizer and supplement industries. However, the respondent expressed concern as to whether users would be willing to pay for these products.

Two respondents addressed emerging genetics in crops. The first respondent stated that genetic technology which enhances nutrient uptake is likely to emerge in various crops. For corn, this technology could be 10-15 years away. However, the respondent felt that the fertilizer industry needs to understand and partner with companies involved in these genetic developments. These technologies will ultimately help to address environmental issues. While in the long term these technologies could reduce the demand for fertilizer, there also exists a scenario where farmers apply the same amount of fertilizer and get more into the plant. The respondent felt that while demand could be reduced over time, it would never go to zero since nutrients are always going to be needed. The second respondent felt that improvements in genetics could potentially lead to plants absorbing nitrogen directly from the atmosphere as well as improved ability to draw nutrients from the soil.

In terms of manufacturing, one respondent mentioned that new technologies are being experimented with at the laboratory level to manufacture ammonia through different routes in



order to reduce environmental impacts and reduce reliance on hydrocarbon sources (e.g. natural gas).

Another respondent mentioned that nanotechnology is still a long way out and that nothing tangible currently exists.

Within the inoculant industry, products have evolved substantially over the past ten years. For example, the industry is seeing new platform technologies such as micro encapsulation²¹ of micro-organisms. As well, there is new emulsion technology for foliar/spray application of inoculant products. Finally, novel packaging is helping to improve the shelf-life of biological products.

With respect to biosolids, there is some interest in using anaerobic digestion technologies more effectively. Currently, most municipalities, at least in Ontario, have digesters, but gas production is not sufficient to make it economical to clean the biogas and use it. As such, the municipalities simply flare off the gas produced (primarily methane and carbon dioxide). However, there exists the potential to add fats, oils, grease and other organics to the biosolids in order to increase methane production. Another related technology is pyrolysis.²² The respondent suggested that companies interested in pyrolysis could obtain biosolids for use as a feedstock.

Table 4.3 outlines the challenges and opportunities associated with some of the new technologies identified above.

Table 4.3 Challenges and Opportunities Surrounding New Technologies

New Technology	Challenges	Opportunities
Plant Nutrition - Develop products capable of sensing crop needs	<ul style="list-style-type: none"> It would be necessary to involve multi-disciplinary teams and invest significant resources (i.e., dollars and time) There may also be a high level of risk associated with the investment since desirable results may or may not be achieved 	<ul style="list-style-type: none"> Protect crops against losses Reduce inputs of fertilizer Increase use efficiency of fertilizers Decrease negative environmental impacts (e.g., leaching, greenhouse gases)
Precision Farming Techniques	<ul style="list-style-type: none"> Cost 	<ul style="list-style-type: none"> More balanced nutrient applications
Enhanced Efficiency Fertilizers	<ul style="list-style-type: none"> Sufficient supply Investment required 	<ul style="list-style-type: none"> More sustained plant nutrition Controlling release of fertilizers Reducing environmental impacts
"Green" Products	<ul style="list-style-type: none"> Will users be willing to pay more? 	<ul style="list-style-type: none"> Sustainable agriculture Reducing environmental

²¹ Microencapsulation may be defined as the process of surrounding or enveloping one substance within another substance on a very small scale. Source: http://www.microtekllabs.com/technical_overview.pdf.

²² Pyrolysis is the process of thermal decomposition to produce gases, liquids (tar), and char (solid residue). These pyrolysis products can all be used as fuels, with or without prior upgrading, or they can be utilized as feedstocks for chemical or material industries. Source: <http://www.afrinc.com/services/pyrolysis.htm>.



New Technology	Challenges	Opportunities
		impacts <ul style="list-style-type: none"> • Environmental improvements
Crop Genetics	<ul style="list-style-type: none"> • Impinging on demand and growth of fertilizer companies • Potential negative consequences of bio-engineered plants (e.g., more susceptible to disease) 	<ul style="list-style-type: none"> • Partner with organizations involved in crop genetics • Improve knowledge of nutrients and genetics within plant and seed • Create innovative products
Anaerobic Digestion of Biosolids	<ul style="list-style-type: none"> • Municipalities may not want to be involved in bringing additional products to the waste treatment plant 	<ul style="list-style-type: none"> • Potential to use biogas generated for heat or electricity

4.4 Market Opportunities

The following bullets outline respondents' views on the alternative markets (both sectoral and geographical) that the fertilizer and supplement industries should consider exploring.

4.4.1 Sectoral

- ☀ Organic market
 - For supplements, including compost and organic fertilizers, one of the big opportunities lies within the growing organic market.
 - In terms of challenges, there still remain a number of uncertainties regarding organic certification. However, the implementation of the national organic certification program in Canada by December 2008²³ should improve the process domestically.
- ☀ Biofuels
 - The shift to biofuels presents opportunities both domestically and internationally.
 - In Canada, greater production of crops due to the demand created by biofuels may require larger amounts of fertilizer. A similar situation exists in international markets, although different feedstocks may be used.
- ☀ Environmental remediation
 - In some progressive regions in the US, organic matter is being restored in brownfields²⁴ or mitigated wetlands through the use of composts and organic fertilizers. While this market is not agriculture focused, it may present an opportunity for the supplement industry to help improve environmentally degraded areas.

²³ By the end of 2008 the Canada Organic logo will be permitted for use only on those food products certified as meeting the revised Canadian standard for organic production and that contain at least 95 percent organic ingredients. Following this phase-in period, it will be mandatory that all organic products be certified for interprovincial and international trade (CFIA, 2007).

²⁴ Brownfields are abandoned or under-used industrial and commercial facilities where expansion or redevelopment is complicated by real or perceived environmental contaminations (US EPA, 2006).



- For biosolids, opportunities exist in land reclamation such as restoring mine tailings, quarries and gravel pits. However, transportation costs represent a challenge in terms of economic viability.
- ☀ Forestry
 - There are opportunities to export products to Brazil for use in forestry fertilization.
 - Within Canada, there may be potential to use biosolids in forestry plantations, if transportation costs can be overcome.

4.4.2 Geographical

- ☀ United States
 - Although there has been an increase in demand in US markets recently, one respondent felt that fertilizer demand was likely to stagnate at high levels and not show any significant growth over the next 5 years.
 - One respondent stated that Canada is already taking advantage of proximity to the US.
- ☀ European Union
 - One respondent stated that the EU market is stagnating.
 - One respondent from the inoculants sector felt that there were significant markets related to canola in the EU and Australia.
- ☀ South America
 - South America, particularly Brazil, represents a potential area for market growth. The Canadian industry has established North-South relationships with companies in South America and should continue to build on these relationships.
 - One respondent from the inoculant sector felt that there were opportunities within legume products in Brazil and Argentina.
- ☀ Africa
 - The fertilizer industry has a unique opportunity to be involved in sub-Saharan Africa. As the economy develops, market demand will be created for fertilizer products. The benefits in the long run (10-25 years) may be significant.
 - One of the major challenges associated with Africa is logistical. Delivery of products to remote areas is difficult. Similarly, exporting food products may be challenging due to weak infrastructure and transportation systems.
- ☀ Asia
 - Asia is where the bulk of demand currently lies and the region will continue to grow. Therefore, the area of focus is and should be on Asia.
 - Demand for potash in East Asia will be significant.
 - Government control of some fertilizer products in India is a barrier and affects supply and access to products.
 - Production of macronutrients is coming on-stream in China. But in the short term, Canada has an enormous opportunity to export to China.
 - The emphasis must be on balanced applications, ensuring that crop needs for macronutrients, micronutrients and supplements are met.

In addition, one respondent identified challenges and opportunities specific to Asia. One of the **major** challenges in Asia relates to intellectual property rights. In Asia, proprietary rights are not respected either because rules do not exist or they are simply not followed. As such, companies are reluctant to bring new technologies to these markets. The respondent felt that influence from



the World Trade Organization (WTO) to ensure that countries abide by intellectual property rights may improve the situation in the future. However, intellectual property rights are definitely a challenge in the current market.

At the same time, the respondent felt that there is a large opportunity for enhanced efficiency fertilizers within the Asian markets. There are two main factors driving the need for enhanced efficiency fertilizers in Asia. First, the nature of the labour market is changing dramatically; people are increasing their employment off the farm and a labour shortage within agriculture is occurring. Second, the increasing focus on the environment means that environmental issues are continuing to rise in importance. For example, there is a lot of fertilizer use in Asia that has the potential for high levels of nutrient loss; therefore, increasing the use of enhanced efficiency fertilizers and reducing environmental impacts would help to reduce this concern. As a specific example of the above two factors, the respondent mentioned that there has been concern lately about high nitrogen rates in vegetables and inappropriate nitrogen use in rice. These crops are best suited to split application of fertilizers. However, due to the shortage of labour, there is a lack of split application occurring. Hence, a market for enhanced efficiency fertilizers exists for controlling the release of nitrogen. The respondent expected that there will still be a lot of small farmers in the next ten years who need products that will release nutrients when the crop requires them, regardless of whether the farmer is available to apply the nutrients.

4.5 Key Success Factors

In order to realize the opportunities described in the sections above, respondents suggested several potential roles of government and industry including key success factors. Key success factors are defined as areas which the industry must focus on in order to achieve its goals.

Respondents made the following suggestions of actions by industry in order to take advantage of emerging trends and opportunities:

- ☀ Be willing to change and invest in research and development.
- ☀ Identify markets where opportunities may occur first and be ready to anticipate and respond. Ensure that detailed market analysis has been conducted in order to ensure that products meet the needs of end users.
- ☀ Work to secure and develop distribution systems in developing economies.
- ☀ Create partnerships with companies in other countries to ease entry into new markets.
- ☀ Be careful to balance supply and demand.
 - Ensure sufficient supply in new markets while avoiding overproduction.
- ☀ Continue to meet as a large group of stakeholders to discuss future goals.

Respondents felt that the public sector could help the fertilizer and supplement industries capture opportunities by:

- ☀ Providing support, including:
 - Sharing and encouraging innovation and research and development.
 - Ensuring effective regulation.
 - Sharing and disseminating information.
 - Ensuring intellectual property rights protection and hence adequate rewards for innovation.



- ☀ Encouraging industry to adopt high standards within the sector for quality, performance, etc.

- ☀ Maintaining export programs:
 - To educate entrepreneurs about international markets and the process of entering these markets.
 - To help industry find international partners.
 - To ensure embassies abroad continue to encourage new market participants and provide assistance.

Overall, respondents emphasized that co-operation between government and industry would help to realize potential opportunities.



SUMMARY AND ANALYSIS OF EMERGING MARKETS AND TRENDS

The purpose of this section is to summarize the information collected in the literature review and industry interviews and to analyze the growth opportunities and emerging markets and trends that exist. This section also presents additional data designed to strengthen and support the information gathered.

To begin with, it is important to understand the trends in the growth of fertilizer consumption globally. Compared to average consumption between 2004/05 and 2006/07, global demand in 2011/12 is expected to increase by 2.6% per year on average (Heffer, 2007). The bulk of the increase in demand is expected to come from Asia and, to a lesser extent, Latin America (Heffer, 2007). Overall, 70% of growth is attributed to South Asia (India, Pakistan, Bangladesh, Nepal, among others) and East Asia (China, Japan, Indonesia, Korea, Vietnam, etc.) combined (Heffer, 2007). Another 15% of the increase in demand is attributed to Latin America where high commodity prices and biofuels are driving demand (Heffer, 2007).

Expert opinion suggests that the growth rate of demand for micronutrients is approximately double that of macronutrients (i.e. 4-5%). Nutrient deficiencies within soils are driving this growth. These deficiencies cause problems in terms of food security and nutrition security.

Anecdotal evidence indicates a trend toward greater use of supplements, primarily driven by concern for the environment and increases in organic production.

Overall, there appears to be four main drivers of growth for fertilizers and supplements: biofuels; food and nutrition security; environmental concerns; and organic production. The following sections summarize the opportunities and challenges associated with each of these drivers.

5.1 Biofuels

The movement towards biofuels is driven by concern for the environment, government policy, and a desire for greater energy security. This movement is resulting in higher commodity prices and increased crop production thereby creating increased demand for fertilizers and supplements as a whole.

Around the world, different regions are using different feedstocks to produce ethanol and biodiesel. As such, their fertilizer requirements will be different (refer to [Table 2.3](#)). Indonesia and Malaysia are expected to expand the use of palm oils in biodiesel production, thus requiring increased fertilization and, particularly, an increase in the use of potash (IFA Task Force on Bioenergy, 2007). The EU is expected to continue producing large amounts of rapeseed for biodiesel (IFA Task Force on Bioenergy, 2007). For the Canadian fertilizer and supplement industries, two primary areas of focus are the US and Latin America, particularly Brazil.



United States

The Canadian fertilizer and supplement industries are already taking advantage of their proximity to the United States. The biofuels movement has caused an increase in corn acreage, resulting in an increase in demand for fertilizers. As well, farmers may increase fertilizer application rates to improve soil fertilizer levels in order to allow for corn on corn rotations (IFA Task Force on Bioenergy, 2007).

Given the current high levels, growth in fertilizer demand in the United States is expected to be limited over the next 5 years. The IFA predicts growth rates slightly above 1% per year for the three primary macronutrients (Heffer, 2007).

Challenges for the fertilizer industry with respect to the US market include high fertilizer prices and the potential development of alternative feedstocks for biofuels. High fertilizer prices tend to reduce demand. [Appendix B](#) provides a graph outlining the increases in fertilizer prices paid by farmers in the United States in recent years. The development of alternative feedstocks, such as cellulose, represents a challenge to the fertilizer industry given that these feedstocks may require lower levels of fertilization than current sources.

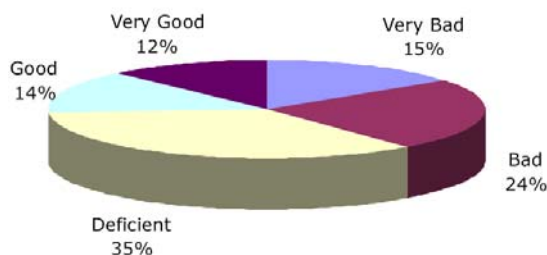
Brazil

Brazil currently represents 65% of the fertilizer market in South America, followed by Argentina and Colombia (Daher, 2007).

Brazil's biofuel production is predominantly from sugar cane (for ethanol) and soybeans (for biodiesel). Production of these crops is expected to increase by 12% and 34% respectively, from 2006 to 2011 (Heffer, 2007). In addition to local uses, the sugarcane will be used to supply ethanol for other regions such as the United States, the European Union and Asia where demand will exceed supply. In fact, Brazil is forecast to supply 84% of the ethanol deficit in other countries in 2011 (refer to [Table 2.2](#)). Given increasing levels of crop production in sugarcane and soybeans (as well as other crops due to high commodity prices), there exists an opportunity for Canada to increase exports of fertilizer and supplement products to Brazil.

One major challenge associated with the market in Brazil is the lack of proper transportation networks. Figure 5.1 illustrates the poor quality of the majority of roads in Brazil.

Figure 5.1 Road Conditions in Brazil



Source: (Daher, 2007).



5.2 Food and Nutrition Security

Soils, largely in developing economies but also in developed nations, are suffering from nutrient deficiencies. These deficiencies cause problems in terms of food security (i.e., not enough food) and nutrition security (i.e., ensuring that diets contain sufficient nutrients). Many of these nutrients can be effectively supplied through fertilization (Shriram, 2007).

Africa

Soils in Africa are so severely depleted that they represent a major constraint to agricultural productivity (Roy, 2007). Fertilizers are therefore essential for agricultural growth.

In 2006, the African Union Ministers of Agriculture declared that “fertilizer was a strategic commodity without borders.” It was resolved that in order to develop African agriculture and end hunger, fertilizer use should be increased from the current average of 7 pounds per acre to at least 45 pounds per acre by 2015 (West, 2007a). While not much has changed so far, some countries are considering tariff revisions and the introduction of fertilizer subsidies. It is expected that encouragement and support from governments and development organizations will contribute to a progressive but slow increase in fertilizer use across the continent. Significant long term (10 to 25 years) opportunities exist within Africa.

The major challenge in Africa is logistical due to weak infrastructure and transportation systems. Delivery of products to remote areas is difficult. Therefore, to succeed in this market, the fertilizer industry needs to think about potential solutions to the logistical problems in order to develop and secure distribution systems. Another issue is affordability and thus product pricing must be carefully considered.

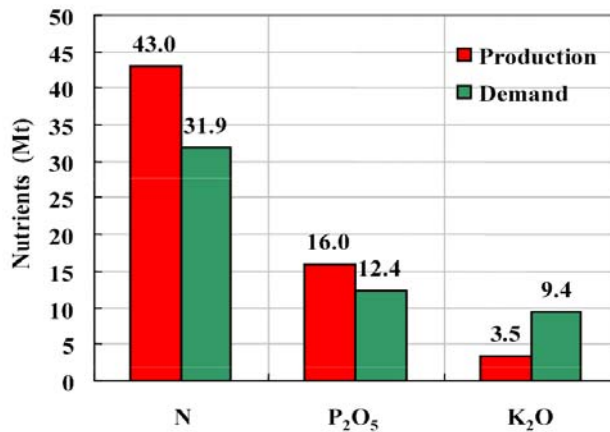
Asia

Soil deficiencies in Asia are also limiting agricultural production. While phosphate consumption is stabilizing, requirements for nitrogen and potash will continue to grow. Sulphur is also emerging as an important nutrient, particularly in India. There is a very large market for micronutrients in Asia in response to soil deficiencies. Overall, it is important to ensure balanced applications of all nutrients in order to address crop requirements.

One of the main challenges in introducing new products into the Asian market is a lack of intellectual property rights protection, particularly in China. Another challenge for Canadian suppliers is the fact that China is strengthening domestic production of macronutrients and will be exporting rather than importing products in the future, as shown in Figure 5.2. However, export opportunities in the short term for Canadian suppliers are significant.



Figure 5.2 Forecast of Fertilizer Production and Demand in China by 2010



Source: (Zhang and Zhang, 2007).

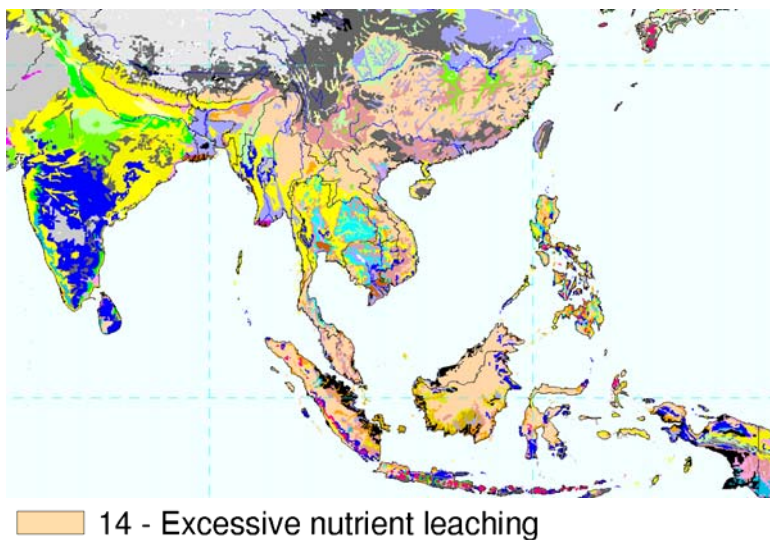
5.3 Environmental Concerns

Concern for the environment is another factor driving the use of fertilizers and supplements, particularly in Asia and North America.

Asia

Environmental issues in Asia are starting to receive greater recognition, especially by governments. Therefore, there may be a very large market for enhanced efficiency fertilizers to address environmental issues, such as nutrient leaching, or in response to future environmental legislation. Although dated, the map shown in Figure 5.3 provides support for the fact that nutrient leaching is a problem in much of Asia.

Figure 5.3 Soils at Risk in Asia



Source: (USDA-NRCS, 1998).



In addition to the environmental issues surrounding nutrient leaching, fertilizer application techniques are contributing to a need for enhanced efficiency fertilizers. Improper application techniques are resulting in environmental problems, creating significant opportunities for enhanced efficiency fertilizers in Asia.

North America

In Canada and the United States, environmental regulations banning the use of chemicals for residential use are becoming more common. In addition, users of fertilizers and supplements are demanding products which reduce environmental impacts. Both of these factors create opportunities for enhanced efficiency fertilizers, organic fertilizers and supplements, and “green products.”

In addition, environmental remediation creates a market for organic fertilizers and compost in order to restore organic matter. This market also presents potential opportunities for biosolids.

5.4 Organic Agriculture

Growth in organic food sales and organic agriculture within Canada and the United States is creating opportunities for compost, organic fertilizers and organic matter.

Studies commissioned by the Organic Agriculture Centre of Canada (OACC) indicate that \$1 billion is a conservative estimate for total retail sales of certified organic products through all market channels in Canada in 2006 (Macey, 2007). In Canada, the organic industry has been growing at a rate of 15 to 20% annually for the past decade (Organic Products Regulations, 2006). Domestic consumption of organic food is expected to continue to grow by 20% annually between now and 2015 (AAFC, 2005 as cited in Olijnyk, 2006). The strong growth in organic food sales creates a need for organic fertilizers and supplements to support organic agricultural production.

In providing products for the organic market, the fertilizer and supplement industries face several challenges. First, the certification process takes time and effort. Second, consistency of product (e.g. compost) is sometimes an issue. Third, the industry must be able to produce and maintain sufficient supply to meet the needs of the growing market.



CONCLUSIONS

There are many emerging opportunities and trends which offer market potential for the Canadian fertilizer and supplement industries.

In order to take advantage of the emerging opportunities, the industry needs to be willing to change and invest in research and development. As well, industry stakeholders need to be ready to anticipate new opportunities and respond with products that suit the needs of users. Entry into new markets is challenging and extensive market research is required for product introduction.

The role of government is to provide support including: investment, innovation, research and development, effective regulation, intellectual property rights protection, and export programs to help companies understand potential markets and establish relationships.

Overall, industry and government need to work together to capture new market opportunities.



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APPENDIX A: INTERVIEW QUESTIONNAIRE



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Emerging Market Trends for the Canadian Fertilizer and Supplement Industries

The George Morris Centre has been commissioned by the Canadian Fertilizer Products Forum (CFPF)²⁵ to identify and assess emerging domestic and international market opportunities for the Canadian fertilizer and supplement industries.

Attached is a questionnaire designed to solicit feedback regarding emerging markets that may create opportunities for the Canadian fertilizer and supplement industries as well as agricultural producers. Sharing your perspective will help to direct the further evolution of the industry.

The questionnaire aims to understand emerging trends within the macronutrient, micronutrient and supplement industries. While the focus of the questionnaire is on fertilizers and supplements for agricultural use, we would also be interested in learning about potential trends in other areas (e.g. lawn and garden, turf, forestry, etc.). In addition, several questions focus on market opportunities in Canada and internationally. The goal is to identify sectoral and geographic markets where Canadian suppliers might be able to expand sales.

The George Morris Centre research team would like to obtain your answers to the questions by telephone interview. A member of our research team will contact you by telephone or email to determine when you are available for an interview that we expect will take 30 minutes of your time. However, if time does not permit an interview, the questions have been designed as a questionnaire that can be completed and returned to us. The results of the research will be made public but the identities of interview respondents will remain confidential.

Please advise us if you feel we should be contacting another individual from your organization.

We thank you in advance for your cooperation.

Sincerely,

Beth Sparling
Research Associate, George Morris Centre

²⁵ The Canadian Fertilizer Products Forum (CFPF) is a stakeholder-led initiative focused on policy development, communications and research activities within the fertilizer and supplement industries. The CFPF was launched in November 2006.



Customer Needs

- Q1:** As we move into the future, what are the changing needs of users (e.g. agricultural producers, golf courses, horticulturalists) of fertilizers and supplements?
- Q2:** What factors, if any, may influence the needs of users of fertilizers and supplements in the future?

Trends

- Q3a:** What trends do you see emerging in the macronutrient²⁶ industry?
- Q3b:** What trends do you see emerging in the micronutrient²⁷ industry?
- Q3c:** What trends do you see emerging in the supplement industry (e.g. inoculants, growth regulators, wetting agents, limestone, humates and compost)?
- Q3d:** If you identified an emerging trend, what are the challenges and opportunities created by this trend for Canadian suppliers and users?
- Q4a:** What influence do you think new technologies (e.g. nanotechnology) will have on the fertilizer and supplement industries?
- Q4b:** What are the challenges and opportunities associated with these new technologies for Canada?

Market Opportunities

- Q5a:** Are there alternative markets (sectoral or geographical) that you think the Canadian fertilizer and supplement industries should explore or that your organization is exploring?
- Q5b:** If you identified an alternative market, what are the challenges and opportunities presented for Canadian suppliers?

Key Success Factors

- Q6a:** What are the industry requirements or “key success factors” required to take advantage of the market opportunities that you identified?
- Q6b:** What is the role of the public sector in ensuring that the Canadian fertilizer and supplement industries can take advantage of future market opportunities?

²⁶ The primary macronutrients include: nitrogen, phosphorus and potassium (potash). The secondary macronutrients include: sulphur, magnesium and calcium.

²⁷ The micronutrients are: boron, chloride, copper, iron, manganese, molybdenum and zinc.



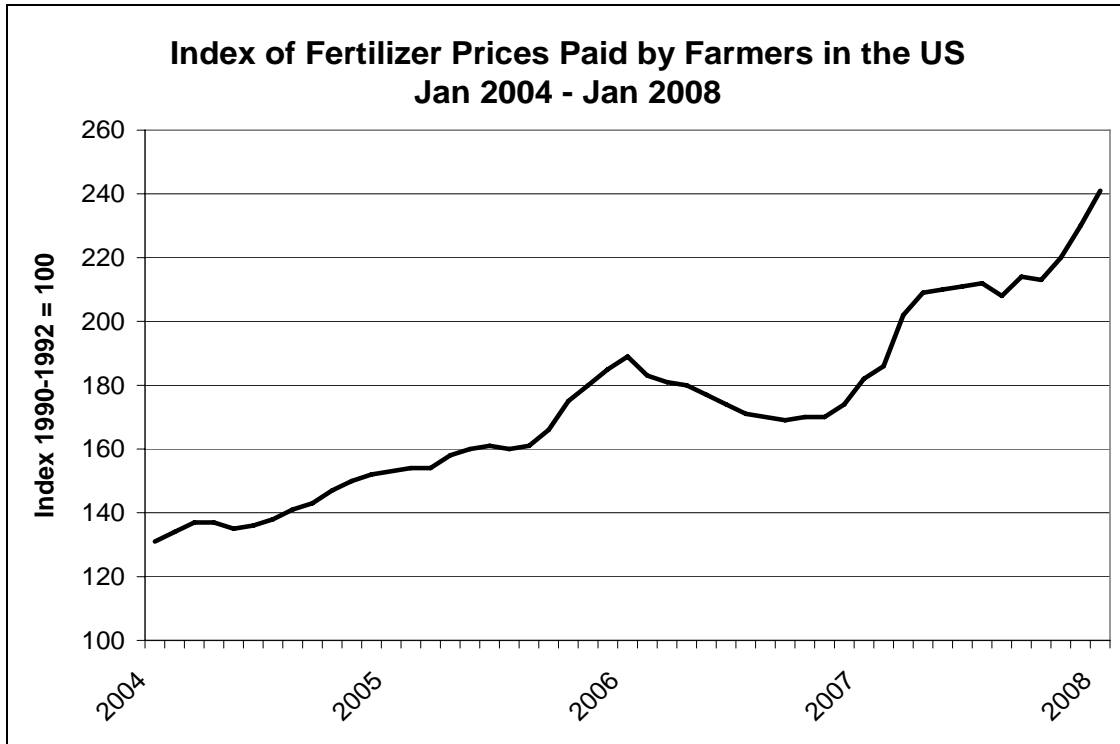
Further Information and Documentation

- Q7a:** Do you have suggestions of documentation that would be helpful in our exploration of market opportunities for the Canadian fertilizer and supplement industries?
- Q7b:** Do you have suggestions of other persons with whom we should be speaking to further explore market opportunities for Canada?
- Q8:** Are there any other comments that you would like to make that were not addressed in this questionnaire?

The George Morris Centre thanks you for your time and interest.



APPENDIX B: FERTILIZER PRICES IN THE UNITED STATES



Source: (USDA-NASS, 2008).