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FORCES AFFECTING CHANGE IN CROP PRODUCTION AGRICULTURE

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A number of factors are significantly reshaping crop production agriculture in the United States. Consider the following:

- Concentration has been on a steady rise for several decades. Today, 75% of the value of primary field crop production—corn, soybeans, wheat, cotton, rice, sorghum, and barley oats—is produced by 40% of U.S. farms (USDA-NASS, Census of Agriculture, 2007).
- Productivity increases have been significant. Corn yields increased from an average of 55 bushels per acre in 1960 to 165 bushels in 2009—a 300% increase in 50 years. Wheat and soybean yields have seen 215% and 169% increases, respectively, over the same period. Meanwhile, according to the cost and returns survey of USDA's Economic Research Service, variable costs of corn production have declined on a real basis from $0.94 per bushel in 1975 to an estimated $0.63 per bushel in 2005.
- Producers are adopting larger pieces of equipment and more sophisticated technologies. Some estimate the time to plant and harvest the crop, two of the most time consuming operations, has been cut in half in the last decade, allowing producers to effectively manage more acres within one operation (Table 1).

Table 1

Estimated Row Crop Planting and Harvesting Capacity over Time

	Planting Efficiency		Harvesting Efficiency	
1970	40 acres/day	4 Rows @ 2 mph	4000 bushels/day	4 rows @ 12hr/day
2005	420 acres/day	16 Rows @ 6 mph	30000 bushels/day	12 rows @ 12hr/day
2012	945 acres/day	36 Rows @ 6 mph	50000 bushels/day	16 rows @ 12hr/day

Source: Land O'Lakes Member Services Interview with Great Lakes Manufacturing Experts, 2008.

Crop agriculture is clearly no stranger to change. This article examines the key forces affecting change in U.S. crop production. We describe some of the major industry drivers of change and use Porter's Five Forces analysis to examine the economic conditions, opportunities, and threats facing this industry (Porter, 1979). Through this discussion, we describe how major crop production businesses are adapting to a changing

competitive landscape. We begin with an overview of the drivers of change for the industry and then discuss the factors influencing profitability and the implications for the future.

Drivers of Change for the Industry

There are several key factors shaping the economic conditions of the crop agriculture industry. Four dominant forces are currently at work—Growing and Diversified Demand; Technology; Resource Availability; and Societal Influences. Each in isolation, and also in combination, has implications for the structure of crop production, including farm size, the business models used, and relationships to other parts of the industry.

Growing and Diversified Demand

The food, feed, and fiber industries are being challenged to meet a growing and diversified demand. According to the Population Reference Bureau's 2010 Population Data Sheet, the global population is expected to reach almost 9.5 billion by mid-2050, with the majority of the additional 2.6 billion people located in developing countries where the need for affordable, abundant supplies of basic plant and animal based nutrients is greatest (Table 2).

Table 2

World Population Growth Estimates.

Region	Population Mid-2010	Population Mid-2025	Population Mid-2050	Population Allocation 2010-2050	GNI PPP per Capita (US$) 2008
	billions				
Less Developed	5.66	6.82	8.16	2.50	5,150
More Developed	1.24	1.29	1.33	0.89	32,370
World	6.90	8.11	9.49	3.39	$10,030

Source: Population Reference Bureau. 2010. World Population Data Sheet. Using the United Nations region/country classification system.

Note: GNI PPP per Capita is Gross National Income Purchasing Power Parity/midyear population

In addition to growing demands for food, feed and fiber, industrial applications for agricultural production are emerging as well. The energy, polymers, chemicals, and pharmaceuticals industries are increasingly looking to the agricultural sector to supply renewable raw materials for their processes.

Technology

Monitoring and information technology, biotechnology, and a variety of other technologies are converging in agriculture to fundamentally change the way crops are grown. Today, yield monitors and GPS, global information systems (GIS), satellite or aerial photography and imagery, weather monitoring and measuring systems, and plant and soil sensing systems are commonly used tools.

Biotechnology applications shorten the cycle time to develop new hybrids and varieties with higher yield potential and stronger resistance to pests and environmental conditions. By combining biotechnology with

mechanical and other technologies to control the growth environment—moisture, pest and disease infestation, etc.—the process control approach that defines the traditional mechanical manufacturing assembly line also transforms agriculture into a biological manufacturing industry.

Resource Availability

The availability and cost of natural resources for the agricultural sector has a significant impact on its capacity to respond to growing demand. In some cases, higher prices will be required to bring additional supplies onto the market or to use existing resources more intensively. This is the case for resources such as land, fertilizer, and irrigation. In contrast, supplies of phosphorus and potash are nonrenewable. As agricultural product demand increases, the owners of land, water, and fertilizer resources will benefit.

Societal Influences

The development of the "bioeconomy" and the growing use of renewables have intensified the discussion of the complementary or competitive nature of the economic motivation of creating value and the social motivation of environmental responsiveness and sustainability. Likewise, societal concerns over the use of genetically modified organisms have shown that public opinion can significantly influence the ability of agricultural operations to utilize new technologies in crop production.

Agribusinesses that rely heavily on natural resources cannot ignore the environmental and social issues that are prevalent today. Faced with increasing government regulations and strengthening public opinions, businesses are ever more accountable for their impacts on society and more transparent in their corporate social responsibility activities. In fact, Rankin (2010) found that 68% of agribusiness firms surveyed were either planning or actively implementing broad sustainability initiatives.

Factors influencing Crop Production Profitability

The above drivers will significantly shape the U.S. farming sector. The potential profitability of farmers is influenced in part by the economic characteristics of the industry. These economic characteristics can, in large part, be examined using Porter's five forces model. Porter posits that the key economic features of an industry can be identified by examining how suppliers, buyers, rivalry, substitution, and barriers to entry affect it. We use this framework to analyze the economic characteristics of crop production agriculture.

Suppliers

The major supplies, or inputs, for grain/oilseed producers are genetics, crop chemicals, equipment, fertilizers and land. Nonfamily labor on farms is becoming a more important input as well. However, in general, producers are able to substitute capital equipment for labor.

Input suppliers to grain/oilseed production tend to be dominated by large agribusiness firms that compete vigorously for farmer business. The substantial investment required to develop new genetics, crop protection chemicals, and automated equipment necessitates that the firms competing in this sector must achieve substantial economies of scale. The investments required to breed and engineer new crop varieties and traits require significant time and substantial costs for regulatory approval. In the short run, intellectual property rights may allow some firms to capture a significant amount of the value created by their technologies. However, the similarity of many competing seed traits and chemistries allows producers to switch products at relatively low costs, thus reducing the bargaining power of input suppliers.

Recent large price increases have drawn attention to consolidation in the fertilizer industries. In particular, the potash market has relatively few raw input suppliers. Grain/oilseed producers are subject to substantial price shocks as suppliers are able to pass cost increases in the short-term on to farmers. In the longer-term, there are alternatives that have the potential to reduce this supplier control. There is substantial potential for grain/oilseed producers to better recycle and more efficiently utilize livestock waste nutrients for crop production. However, those crop producers without access to these alternatives will likely continue to face pressure from volatile fertilizer markets.

Capital is a critical input to modern agricultural production. The U.S. capital markets are extremely efficient

and competitive. This presents U.S. producers with a significant advantage over many of their foreign competitors. The establishment of the Farm Credit System was a strategic response to the competitive situation in agricultural lending. Today, agricultural credit is widely available to creditworthy producers.

Buyers

The grain/oilseed sector markets its products to three major sets of customers: grain merchants and handlers, livestock producers, and renewable energy/industrial users. While exports are also critical to the sector, we focus on the domestic and international markets where grains/oilseeds are used.

The first key customers are grain merchants and handlers that aggregate farm output into meaningful quantities that can be delivered to end users and processors. These customers also have the key role of storing a crop that is harvested in a few months and consumed over the course of a year. These firms are typically private companies and traditional farmer cooperatives. Today, there is substantial concentration among the private grain handling and merchandising companies. Crop producers, however, are still able to market their products on reasonable terms. And, the U.S. Department of Justice has shown a willingness to eliminate potential market power advantages in this industry segment when necessary. Overall, the economic structure of this portion of the grain/oilseed supply chain is unlikely to adversely impact the profitability of grain/oilseed producers because they can easily switch between competing handlers and/or invest in their own storage and handling facilities.

The second key set of customers for grain/oilseed producers is the animal agriculture sector. Feed use currently accounts for roughly half of grain/oilseed demand. Although livestock farms, too, have undergone dramatic consolidation in recent decades, they remain, by and large, unable to exert significant pressure on grain/oilseed producers. However, the expansion of animal protein markets is important for expanding demand for grain/oilseed production. Beef, pork, and dairy producers have all recently experienced significant financial hardship as feed costs escalated from increasing overall grain/oilseed demand. In the future, a healthy and vibrant animal agriculture sector is critical to the long-term profitability of grain/oilseed producers.

The renewable energy and industrial food manufacturing sector is the third key customer of grain/oilseed producers. This sector has recently undergone dramatic growth and also significant concentration, with a number of mergers and acquisitions among ethanol and food manufacturers. However, because grains/oilseeds are traded as commodities, the ability of the sector to exert significant buyer power over producers is limited.

Customers likely will not exert significant, negative influences on industry profitability in the future due to traditional concerns over concentration. Instead, the impact of these industries will be driven by their fundamental profitability. Here, there is some cause for concern. The large increases in demand associated with renewable energy production, for example, are largely policy driven. Should the policy become less attractive to renewable energy production, there could be significant declines in biofuel demand. Likewise, these industries are highly competitive and dependent upon energy prices. Sustained low, energy prices would significantly reduce demand from these customers. Animal agriculture should significantly benefit from rapid population and economic growth in China and India. However, animal protein is generally a higher cost source of protein, and slowing economic growth in these countries would significantly reduce demand for animal protein and hurt grain/oilseed producers.

Rivalry

Agricultural production is characterized by a high degree of competitive rivalry. Efforts to develop branded or specialized products are quickly and effectively copied, and meaningful differentiation is difficult to achieve. The competitive rivalry plays out most clearly in bidding for productive resources. Here, producers typically bid most of their long-term potential profitability into the price of fixed assets such as farmland. As a result, rivalry has a very detrimental impact on individual profitability in the sector. However, it also encourages firms to be extremely efficient and productive as cost competition is the most likely source of competitive advantage. Rivalry has also clearly manifested itself on the global stage as South American agricultural production has rapidly increased to the point where Brazil and Argentina are key world soybean producers. Further, continuing genetic improvements, such as drought resistance, are allowing production of crops in

regions once not suitable.

Substitute Goods

There are important substitution considerations for grain/oilseed producers. Movements away from or towards animal proteins in the diet can have a significant impact on grain consumption. Grain products also compete in a variety of industrial based markets, such as energy and bioplastics where they serve as a substitute for petroleum-based products. These markets are quite large, but are also highly competitive. The large quantities of these available substitutes will limit producer profitability.

Barriers to Entry

There are few meaningful barriers to entry in production agriculture. While the capital requirements can be substantial to a young person trying to begin a career in farming, these requirements are not prohibitive for most businesses considering large-scale entry. For larger investors and pension funds considering entry into agriculture, the barrier in the United States is typically finding enough land in one geographic area to make a significant investment. While still limited in number, there are more farm management companies pursuing large scale farmland investments operated through both internal and external management arrangements. Funding for these enterprises increasingly comes from equity markets. The relative ease with which parties with access to capital can enter crop production will limit the upside profitability potential for current producers.

Conclusions and Implications

An increasing and diverse demand, rapid adoption of new technologies, limitations on global agricultural resources, and a society with increasing expectations of agriculture to produce a safe, abundant, affordable—and now "sustainable"—supply of food, fiber, feed, and energy will all shape the future environment for crop producers. In addition, crop producers' ability to generate profits will change with the profitability prospects of input suppliers, customers, competitors, substitutes, and new entrants.

The drivers of change suggest it will be critical for crop producers to be diligent in their pursuit of ever increasing productivity. To meet the demands of a growing global population with limited natural resources and increasing societal requirements, producers will need to continue to increase yields per acre at increased rates. At the margin, total production can be increased by bringing new lands into production, but those available, productive lands are limited. Thus, technology adoption will continue to play a crucial role in enhancing the sector's productivity. The pace with which these technologies are developed and adopted will depend on both the economics of crop production and society’s willingness to accept the new technologies. We believe it is not a matter of if new technologies will be adopted, just a matter of the speed with which they are adopted.

An analysis of Porter's Five Forces that affect profitability indicates that scale efficiencies will continue to be a critical driver of a crop producer’s competitive position. In particular, while customer buying power and input supplier power are not considered to be major deterrents to profitability, inter-firm rivalry and the relative ease of entry into the sector will continue to place pressure on the industry. While competition in the customer segments will keep buyers from significantly influencing the general market, the number of producers in a given crop producing area and the lack of differentiation make bargaining against customers very difficult without significant scale. Bargaining power usually requires some form of scale which allows the amount of product controlled to be significant in the marketplace. This is either done through scale within the operation or formal collaborations with other firms to appear bigger to the marketplace. This may be in the form of cooperatives, partnerships, LLC’s, etc. and may include local, regional, national, and/or international collaborations.

In addition, the competition for limited, available land is fierce, and those producers with greatest efficiency are at a competitive advantage in acquiring those resources. While scale efficiencies normally suggest expansion of the farming operation size, producers will also have to purposefully improve the productivity of the land they manage. This will require the adoption of technologies that allow producers to drive down costs per unit, including a combination of information, biologic and other technologies.

In the future, crop producers likely will also have increased opportunities to differentiate their businesses and

commodity production. Synergistic activities including marketing fertilizer from livestock waste, providing services to other producers including grain storage and trucking, and even off-farm employment all could become viable business opportunities. Producers able to meet unique contract specifications or negotiate preferred supplier contracts may ultimately increase their profitability by reducing their reliance on traditional commodity production and markets.

For More Information

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