FARMING IN THE 21ST CENTURY

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Preface

The U.S. agricultural industry is in the midst of major structural change — changes in product characteristics, in worldwide production and consumption, in technology, in size of operation, in geographic location. And the pace of change seems to be increasing. Production is changing from an industry dominated by family-based, small-scale, relatively independent firms to one of larger firms that are more tightly aligned across the production and distribution chain. And the input supply and product processing sectors are becoming more consolidated, more concentrated, more integrated.

Agriculture in the 21st century is likely to be characterized by: 1) adoption of manufacturing processes in production as well as processing, 2) a systems or food supply chain approach to production and distribution, 3) negotiated coordination replacing market coordination of the system, 4) a more important role for information, knowledge and other soft assets (in contrast to hard assets of machinery, equipment, facilities) in reducing cost and increasing responsiveness, and 5) increasing consolidation at all levels raising issues of market power and control.

These profound changes in the agricultural industry present new challenges and new opportunities that require new ideas and concepts to analyze and implement. They require new learning and thinking. Some of those new ideas and concepts are presented here, not as empirically verified truths, but as "thoughts" to stimulate different and better thinking. They have been developed based on observations, analysis and discussions with numerous managers and colleagues in agribusinesses in North America and Europe. This series focuses on Farming in the 21st Century; companion series are also available on Financing and Supplying Inputs to the 21st Century Producer (Staff Paper 99-11), and Value Chains in the Food Production and Distribution Industries (Staff Paper 99-10).

Our purpose in sharing these "thoughts" is to invite discussion, dialogue, disagreement — in general to encourage others to develop better "thoughts".

Keywords: qualified supplier, biological manufacturing, strategic risk, process control, economies of size, franchise grower

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Farming in the Future

Production agriculture is destined to face dramatic changes in the future based on both the globalization of the economic climate and changes in the consumer or end-user of agricultural products. The new agriculture will be characterized by:

1. Global competition
2. Industrialization
3. Differentiated products
4. Precision (information intensive) production
5. Supply chains

More Global Competition

Globalization and internationalization are not new to agriculture — since the 1970's farmers incomes have been heavily dependent on their success in selling products in international markets. More recently the development of agreements such as GATT and NAFTA have been the focal point of much of the globalization discussion with the emphasis on broader access to world markets and expanding exports of agricultural commodities and particularly further processed agricultural and food products.

Expanded market access is not an unimportant dimension of the future of global markets and international trade, but the most important dimension of more open trade is the international transfer of and global access to technology and research and development. Most of the private sector technology transfer and R&D activity has focused on U.S. and Western Europe in the past. Today these are relatively mature markets in terms of acreage growth and expansion of livestock production capacity. Growth opportunities are likely greater outside these regions (i.e. Canada, Mexico, South America, Eastern Europe, Asia, etc.), and with the opportunities for global-oriented companies to expand their markets in these areas, one would expect substantial expansion in the technology transfer and R&D activity of these companies specifically focused on geographic regions outside the U.S. and Western Europe. The longer-run consequences are a narrowing of the gap between the productivity in these parts of the world and that of the traditional dominant production regions, as well as an increase in worldwide production capacity. This increased efficiency, productivity and capacity in other production areas along with the worldwide sourcing and selling strategies of global food companies means that the U.S. and Europe will not be as dominant players and will face increased competition in world markets in the future.

Expansion of Industrialized Agriculture

The current movement toward industrialized production units in the U.S. is nearly complete for some livestock species, but lagging for others. The poultry industry moved to an industrialized model from the 1940s through the 1960s. Cattle feeding moved to the industrialized model in the 1960s and 1970s. The dairy and pork industries are in the midst of a dramatic movement to the industrial model, with the current transition largely to be completed by 2010. The brood cow industry continues to be much less affected by industrialization, as technologies have yet to be found that can greatly increase the productivity of the brood cow through confinement and intensive management. Specialty crops have or are rapidly adopting industrialized production systems. The grain industry is moving more slowly to this type of agriculture, but even segments of the commodity markets are increasingly adopting a biological manufacturing approach.

Industrialization of production means the movement to large scale production units, that use standardized technology and management and are linked to the processor by either formal or informal arrangements. Size and standardization are important characteristics in lowering production costs and in producing more uniform crop products and animals that fit processor specifications and meet consumers' needs for specific product attributes, as well as food safety concerns. Smaller operations not associated with an industrialized system will have increasing difficulty gaining the economies of size and the access to technology required to be competitive, except perhaps in niche markets. Smaller operations can however remain in production for a number of years since they may have facilities that have low debt and are able to utilize family labor. Technological advances combined with continued pressures to control costs and improve quality are expected to provide incentives for further industrialization of agriculture.

Development of Differentiated Products

The transformation of crop and livestock production from commodity to differentiated product industries will be driven by consumers' desire for highly differentiated food products; their demands for food safety and trace-back ability; from continued advances in technology; and from the need to minimize total costs of production, processing, and distribution. Food systems will attempt to differentiate themselves and their products by science and/or through marketing. Ways to differentiate through science include gaining exclusive rights to genetics through patentable biotechnology discoveries; by exclusive technology in processing systems; and by superior food safety integrity. Marketing may include: branding, advertising, packaging, food safety, product quality, product attributes, bundling with other food products for holistic nutritional packages, and presentation of products in non-traditional formats.

In the grain industries, high oil corn acreage has been growing rapidly, and new crops such as high oil corn and soybeans, high protein wheat, and specific amino acid composition soybeans are expanding. In pork, differentiation on lean content is increasingly common. In the future at least two types of pork sire lines will be developed for different markets. One sire line will be selected to produce extremely lean and efficient pigs, with an objective of least-cost for reasonably acceptable lean pork. Other lines destined for export and restaurant markets will be selected for high pork quality. These lines will be darker in color and contain approximately 3 percent intramuscular fat.

Precision (Information Intensive) Production

The management of production is expected to trend toward more micro management of each specific production site, specific room, and possibly even specific acres or animals. The shift will be driven by the influx of information about the environmental and biological factors that affect production. The motivation will be to minimize costs and enhance product quality.

Increased used of monitoring technology will greatly expand the amount of information available regarding what affects plant and animal growth and well-being. This will be made possible by innovations in sensors to use in individual monitoring and control systems. In addition, greater understanding of how various growth and environmental factors interact to affect biological performance will be forthcoming. This understanding will then be designed into management systems which incorporate the optimum combinations and apply them at a micro or localized level.

Precision farming in crop production includes the use of global positioning systems (GPS), yield monitors and variable rate application technology to more precisely apply crop inputs to enhance growth, lower cost and reduce environmental degradation. Examples in animal production include medication treatment by animal rather than by the entire group or the herd; nutritional feeding to the specific genetics, sex, age, health, and consumer market for the individual animal; and continuous adjustment of the ambient environment, including such factors as temperature, humidity, air movement, and dust and gas levels within buildings, to maximize economic returns.

Nutrition management is expected to more closely match the nutrient supply with the needs of individual animals. This will include the matching of specific grains with individual species and perhaps specific genetics, body conformation, gender, phase of life cycle, or even the end-use for the animal. Greater emphasis also will be placed on nutrition to minimize odor and nutrient levels in manure rather than on traditional economic factors such as feed efficiency and rate of gain. For example, phase and split-sex feeding in pork production can reduce total costs of pork production by 4-6 percent. An additional benefit to phase feeding is a 15-percent reduction in nitrogen and phosphorous excretion.

Buildings and equipment will continue to move toward larger scale to fit the industrialized model. Inside the buildings, expect enhancement of monitoring and control systems to help detect gases, temperature, humidity, and disease organisms that could adversely impact the economic performance of animals, and correct problems when they reach critical thresholds. Further advancements can be expected in cleaning systems to maintain higher sanitation, improve conditions for workers and in animal handling systems to reduce injury to animals in movement and marketing.

Formation of Food Supply Chains

Much of U.S. plant and animal agriculture will be a part of industrialized food systems by the year 2020. Industrialized food systems are those which are holistic in production processing marketing, and organized to deliver specific-attribute consumer products by development of optimized delivery systems or through differentiation by science or branding.

An increasing emphasis will be placed on managing and optimizing supply chains from genetics to end-user/consumer. This supply chain approach will improve efficiency through better flow scheduling and resource utilization, increase the ability to manage and control quality throughout the chain, reduce the risk associated with food safety and contamination, and increase the ability of the crop and livestock industries to quickly respond to changes in consumer demand for food attributes.

Food safety is a major driver in the formation of chains. One way to manage food safety risk is to monitor the production/distribution process all the way from final product back through the chain to genetics. A trace-back system combined with HACCP (Hazard Analysis Critical Control Points) quality assurance procedures facilitates control of the system to minimize the chances of a food contaminant, or to quickly and easily identify the sources of contamination.

A supply chain approach will increase the interdependence between the various stages in the food chain; it will encourage strategic alliances, networks, and other linkages to improve logistics, product flow, and information flow. Some have argued that in the not-too-distant future, competition will not occur in the form of individual firms competing with each other for market share, but in the form of supply chains competing for their share of the consumers' food expenditures.