



*Eight themes
characterize the
new agriculture*



U.S. Agriculture in the 21st Century

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The U.S. food production and distribution industry is in the midst of major structural change — 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 value chain. Food retailing is increasingly more customer responsive, more service focused, and more global in ownership. In addition, the input supply and product processing sectors are becoming more consolidated,

more concentrated and more integrated. In this article we examine the themes and dimensions of these changes, and the impact they may have on your business.

More global competition
Globalization is more than commodity imports and exports — it involves broad economic integration involving capital flows, foreign direct investment, trade in products and services, and immigration rules. There are four drivers of globalization: (1) Information technology — advances in information technology have improved firms' ability to evaluate and monitor consumer demand and created an expanded geographic market for

firms; (2) Improvements in transportation — firms can now supply markets in previously unattainable regions of the world due to improvements in transportation, logistics, scheduling and delivery; (3) Capital mobility — financial and speculative capital, previously available primarily in Western Europe and North America is more mobile and available worldwide; (4) Technology transfer — as firms operate globally the nature of worldwide technology transfer and R&D activity changes to within firms through foreign direct investment and subsidiaries. The relative role of direct international technology transfer and international research institutes is declining.

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The longer-run consequences are an increase in worldwide production capacity in different regions of the world. 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 United States and Europe may not be as dominant and will face increased competition in world markets in the future.

2 Biological manufacturing Farming is being transformed from growing crops to manufacturing biological based specific attribute raw materials. Biological manufacturing has characterized the fruit and vegetable and poultry sectors for a number of years.

Industrialized pork production and distribution is becoming the norm. In the beef industry, cattle

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feeding follows the industrialized model but the brood cow industry is much less affected. In the grain

industry, specialty crops are rapidly adopting industrialized production systems, with commodity grains following.

Industrialization of production means the movement to large-scale production units that use standardized technology and management and are linked to the processor by formal or informal arrangements. Size and standardization are important in lowering production costs and in producing more uniform crops and animals that fit processor specifications and meet consumers' needs for specific product attributes, as well as food safety concerns. The movement to large-scale production units that use standardized technology and management is an integral part of biological manufacturing.

Process control technologies critical in biological manufacturing are: monitoring/measuring information technology to real time monitor and trace development and/or deterioration of attributes; biological/nutritional technology to manipulate the attribute development and deterioration process in plant and animal production and processing; and intervention technology such as computer controlled irrigation systems to close the gap between actual performance and production potential.

3 Development of differentiated products The transformation of crop and livestock production from commodity to differentiated product industries is driven by advances in

technology and the need to minimize total costs of production, processing, and distribution as well as by consumer demand for highly differentiated food products, food safety and trace-back. Differentiation may occur by science or marketing. Differentiation by science may occur as a result of acquiring exclusive rights to genetics or owning exclusive technology in processing systems. Marketing differentiation may include branding, advertising, packaging, food safety, product quality, product attributes, and product bundling.

Product differentiation is affecting firms at all stages of the value chain and often results in the ability to capture a higher selling price, but also typically

requires higher costs. Farmers growing specialty grains face higher transportation and management costs in addition to higher seed costs. Changes in the seed industry include a shortened product lifecycle and product proliferation. These changes are resulting in increased inventory costs, average inventory levels, cost of carry-over, stockout costs and safety stock costs. However, margins are generally higher for differentiated products, often more than covering the extra costs.

4 Formation of value chains The delivery of specific-attribute consumer products requires a more holistic approach in agricultural production, processing and distribution. The

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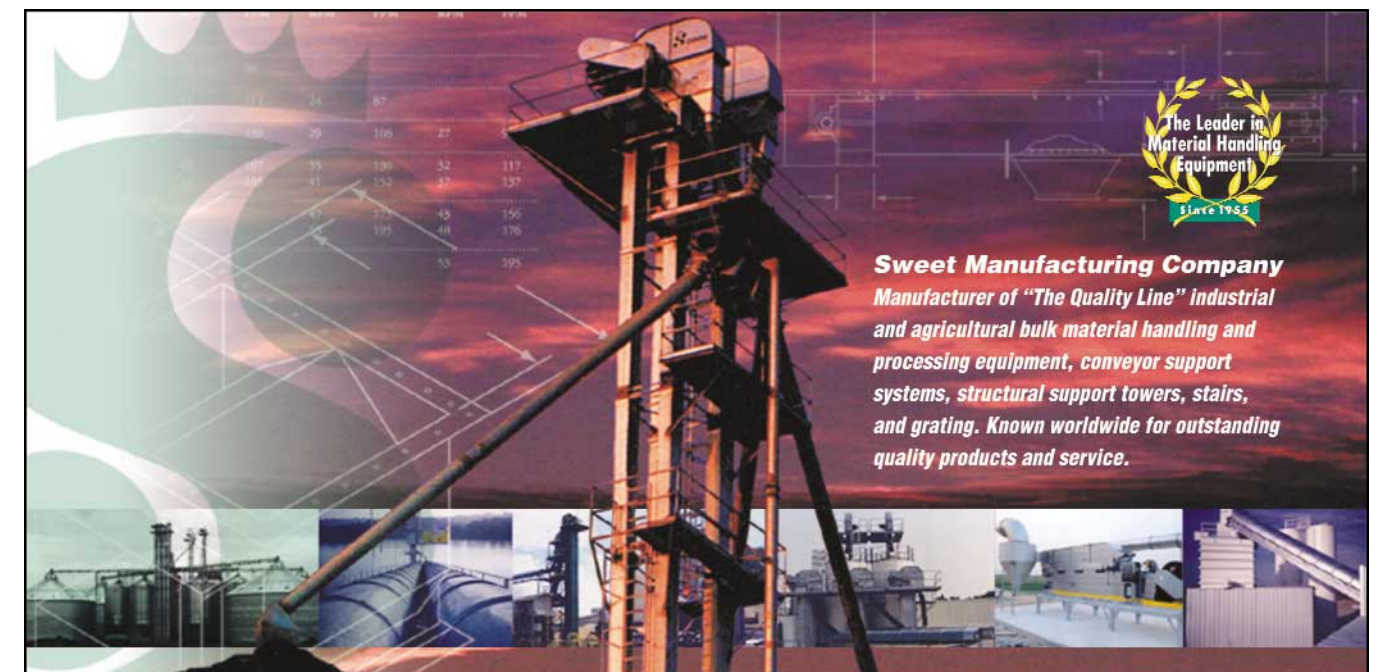
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emphasis on managing and optimizing value chains from genetics to the enduser/consumer is increasing. Efficiencies are achieved through better flow scheduling and resource utilization; increased ability to manage and control quality throughout the chain; reduction of risk associated

with food safety and contamination; and increased ability to quickly respond to changes in consumer demand for food attributes.

Coordination along a value chain can be an important way to reduce some of the additional costs resulting from differentiated products. In particular, increased

costs associated with inventories and transportation can be minimized when the stages of the value chain work together.

A value chain structure is a fundamentally different approach than traditionally used. The focus is on the function performed and not on the firm or individuals that perform it. There is an increased interdependence between the various stages of the food chain. Competition and rivalry is no longer between individual firms but between value chains competing for their share of consumer's food expenditures.

5 Precision (information intensive) production

The management of production is expected to trend toward more micro management of specific production sites, specific rooms, and specific areas or animals. This shift will be driven by the influx of information about environmental and biological factors and how they affect production.

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 herd; nutritional feeding to the specific genetics, sex, age, health and consumer market; and continuous adjustment of the ambient environment to maximize returns.

The adoption of precision technology varies from firm to firm and depends on competitive pres-

ures, the goals of the firm and the extent of firm level resources. Increased use of monitoring technology will greatly expand the amount of information available regarding what affects plant and animal growth and well-being. This understanding will then be designed into management systems that more closely match the nutrient supply with the needs of plants and animals at a micro level.

6 Increasing risk

Risk is nothing new to agricultural production. However, the extent and nature of risk is changing with industrialization, the development of differentiated products, and the formation of value chains. The traditional sources of risk in agriculture are: price, weather and disease.

New sources of risk, that occur as a result of differentiated products, include: consumers' and end-users' attitudes and willingness to pay for certain attributes may change over time; as others develop the expertise to produce the new product it becomes commoditized, lowering the premiums that could be received; and the risk of brand value declining as a result of defects or quality lapses.

The movement of firms to be part of tightly aligned value chains results in efficiencies but also additional risks associated with whether the product attributes are measurable and demand for the attribute is predictable. In addition, relationship risk must now be managed. As value chains become more dominant, traditional markets become "thinner" and often take on the role of "salvage"

markets. The fundamental issues of access to information, transaction transparency, equitable sharing of risk and rewards by non-participants as well as participants in tightly aligned value chains, and the risk associated with market access are all important market risk and performance

issues that impact the structure of agriculture.

7 More diversity
Agriculture of the future will exhibit more diversity among businesses with individual businesses more specialized. The representative "Iowa corn farm" or "Texas



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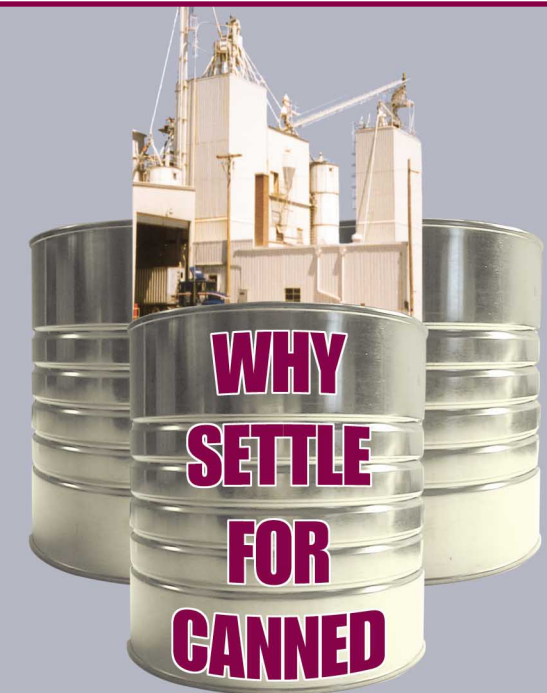
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beef farm" will be a thing of the past. One source of diversity arises from the separation of production activities by phase (e.g., separate firms for breeding, gestation and farrowing in pork production).

A second source of diversity is development of differentiated products. As farms move from producing commodities to specific attribute raw materials, diversity results (e.g. corn farms diversified according to white corn, high oil corn, etc.). Other forms of diversity involve differences in dependency on farming as a source of income, differences in size, and differences in marketing and financial strategies. A final source of diversity is the firm's production technology and degree of capitalization.

Important conclusions from the Center for Food and Agricultural Business Commercial Producer Project provide consistent results.

Today's producers are confident, successful professionals who use information and technology to make complex and effective business decisions. In dealing with producers it is

important to not only remember that "One Size Does Not Fit All," but that one size may fit only one or a few producers. Success in the future may require increasingly sophisticated market segmentation.

8 Emergence of ecological agriculture

In recent decades there has been an increased awareness of the importance of the perspective and practice of ecological agriculture. Proponents of ecological agriculture argue that agriculture cannot function as an isolated system and must consider the limits of the natural resources used to produce agricultural commodities as well as the limits of the sinks needed to dispose of the wastes from agricultural and nonagricultural activities.

In addition, the increasing awareness of ecological systems questions the sustainability of the predominant paradigm — that production problems are most effectively solved by bringing an external counterforce to bear (e.g., applying a pesticide to a pest). It is

argued that this approach creates a treadmill phenomenon where new rounds of pests are ever present since nature is evolving. In contrast, an ecological approach would determine why the pest is a pest and discover how improving internal relationships in the system could solve the problem. These differences in fundamental approach to production have significant structural implications since the external counterforce method tends to be more capital intensive.

As energy costs increase, waste disposal problems worsen, resistance to pesticides accelerates, environmental pressures intensify, and market opportunities for identity preserved, ecologically produced food grow, ecological farming practices could increase dramatically.

Parting shot

One thing is for certain, change in agriculture is inevitable. In today's environment the pace of change can seem overwhelming. From increasing globalization, to biological manufacturing, and from ecological agriculture to developing vertical relationships the agriculture of tomorrow is rapidly departing from the agriculture of today. We don't necessarily have to like these changes but we should at least be aware of them so they don't pass us by. ■

The three co-authors of this state-of-the-industry report are all on the faculty at Purdue University's Department of Agricultural Economics. Dr. Michael Boehlje is a professor, and conducts research and teaches in the area of farm and agribusiness management and finance. Dr. Joan Fulton is an associate professor who teaches undergraduate classes in futures and options, cooperatives, vertical coordination and food marketing management. Dr. Allan Gray is an assistant professor with research interests in agribusiness management and strategic planning.

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