Agribusiness Economics and Management

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Agribusiness scholarship emphasizes an integrated view of the food system that extends from research and input supply through production, processing, and distribution to retail outlets and the consumer. This article traces development of agribusiness scholarship over the past century by describing nine significant areas of contribution by our profession: (1) economics of cooperative marketing and management, (2) design and development of credit market institutions, (3) organizational design, (4) market structure and performance analysis, (5) supply chain management and design, (6) optimization of operational efficiency, (7) development of data and analysis for financial management, (8) strategic management, and (9) agribusiness education.

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In January 1956 John H. Davis, director of the program in agriculture and business at the Harvard Business School, published "From Agriculture to Agribusiness" in the *Harvard Business Review* (Davis 1956). The following year Davis and Ray A. Goldberg published *A Concept of Agribusiness*. These two publications introduced and defined the term "agribusiness" as

> the sum total of all operations involved in the manufacture and distribution of farm supplies; production operations on the farm; and the storage, processing, and distribution of farm commodities and items made from them. Thus, agribusiness essentially encompasses today the functions which the term agriculture denoted 150 years ago.
> (Davis and Goldberg 1957, p. 2)

By the end of 1959, the term had appeared in at least forty published articles and book reviews in ten journals, ranging from the *Journal of Farm Economics* and the *American Economic Review* to *Agricultural History* and the *Journal of Marketing*.

The key insight articulated by Davis and Goldberg was that the food system needs to be viewed as an integrated system. Management strategies and public policy initiatives designed to address problems in the food system would be doomed to failure if they focused on only one portion or segment of that integrated system. Their work stimulated new interest in the linkages between segments of the food system, in coordination across segments, in systemwide performance, and in strategy formulation in a context of interdependence. As Cook and Chaddad (2000, pp. 209–210) note:

> [A]gribusiness research evolved along two parallel levels of analysis: the study of coordination between vertical and horizontal participants within the food chain, known as agribusiness economics, and the study of decision-making within the alternative food chain governance structures, known as agribusiness management.

In 1956 our association was approaching its fiftieth anniversary. Though the term "agribusiness" had not been used prior to that

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time, agricultural economists had been making significant contributions on issues related to agribusiness for many years. As early as 1913, Charles J. Brand (1913, pp. 85–86) noted that the farmer needed "suitable and convenient arrangements for securing credit" and "assistance in the establishment of a marketing system which will return him the true value of the particular qualities of the various crops that he produces, minus reasonable charges for handling, transportation and the legitimate profits of middlemen." These concerns led to significant work on farm credit and cooperative marketing in the 1920s, as well as articles on vertical integration, the organization and operation of marketing firms, and the role of business economics in our teaching programs. New concerns emerged during the 1930s, including the structure of the food distribution system and marketing margins. Other new issues related to agribusiness emerged during the 1940s and early 1950s. These included the rapid growth and concentration of food processing and retailing businesses, analysis of costs and efficiency in food processing plants, and the dynamics of food retailing.

Building on this previous work and stimulated by changing economic circumstances and important new conceptual and methodological developments in economics, the publications by Davis and Goldberg helped initiate a rapid expansion and redirection of agribusiness scholarship during the association's second half century. In the late 1950s and early 1960s, annual meetings included sessions on cooperatives, farm supply markets, industrial organization, vertical integration, market power of food processing and farm supply firms, antitrust decisions, and bargaining. In the mid-1960s the National Commission on Food Marketing was established "to study and appraise the changes taking place in the 'marketing structure' of the food industry and where they might lead; efficiency; services to consumers; market power; regulatory activities; services such as market news; and the effects of imports" (Brandow 1966, p. 1319). Key papers on cooperative theory and agricultural finance also appeared during the 1960s. Research on the evolving sector structure continued in the 1970s along with discussions about how well teaching programs were serving the needs of the rapidly growing nonfarm segments of the food system. Work on food system structure and performance continued into the 1980s, leading to landmark publications by members of the North Central Regional Project 117 (NC-117), "Organization and Control of the U.S. Food Production and Distribution System."

The 1980s also was a time for questioning the place of agribusiness scholarship within the agricultural economics profession. The first issue of a new journal, *Agribusiness,* appeared in 1985. Sonka and Hudson (1989) subsequently provided a conceptual assessment of the need for agribusiness scholarship from both academic and industry perspectives. The interplay emanating from the cultural, biological, and political aspects of food and the differing competitive market structures along the agricultural supply chain were noted as particularly distinctive features of the sector. This article articulated the need for use of a broader range of behavioral sciences within agribusiness scholarship, while recognizing the continued value of economic analysis. In 1990 the International Agribusiness Management Association (IAMA) was formed under the leadership of Ray Goldberg with the objective of extending the range of disciplines contributing to agribusiness research and to foster more interaction between the academic and industry practitioner communities.

This article traces the development of agribusiness scholarship over the past 100 years by describing nine significant areas of contribution by members of our profession—five associated with agribusiness economics and four linked to agribusiness management. Work in all nine of these areas began before the publications by Davis and Goldberg and has continued in subsequent years. Our review of key contributions cannot possibly be comprehensive, but we believe it does characterize the evolution of work in this important area. In doing so, it also establishes a platform for looking ahead to future challenges and opportunities in agribusiness.

Agribusiness Economics

Agribusiness economics is concerned with understanding how institutions, organizations, and markets affect vertical and horizontal coordination within the food system. This section describes five significant contributions that members of our profession have made to the design and analysis of institutions, organizations, and markets.

Contribution #1: Agricultural economists have played important roles in introducing economic reasoning and pioneering theoretical advances in the study of agricultural cooperative marketing and management

In the first major paper on cooperatives in the newly published *Journal of Farm Economics,* Asher Hobson (1921) struck a theme that agricultural economists would continually restate for the next 50 years—the importance of understanding basic economic principles in farmer decision making when initiating joint vertical integration. Emphasizing scale economies, asymmetric information, and other market failure elements as rational economic reasons for forming cooperatives, agricultural economists often confronted the advocacy frenzy of politicians and farm leaders rushing to organize producers into agricultural cooperatives in the post–World War I depression (Nourse 1922; Erdman 1924). They also published warnings of the dangers of moving too quickly without understanding market structure forces or the debilitating implications of inadequate capital and human resources.

During these early years, agricultural economists advanced understanding of market coordination through detailed descriptions of market functions and the costs of participating privately or collectively in specific supply chains. Their emphasis on analyzing the performance and welfare role of marketing cooperatives relative to multipurpose cooperatives continues today.

In addition to the competitive yardstick function and coordination role, agricultural marketing economists concentrated primarily on (*a*) the role of cooperatives in controlling agricultural supply (Erdman 1927), (*b*) the importance of cooperatives in establishing quality standards (Nourse 1922), and (*c*) microanalysis of organizational design (Jesness 1925). Three insightful diagnostic annual meeting proceedings articles by Erdman (1950), Knapp (1950), and Koller (1950) indicate a major turning point in the form of contribution made by agricultural economists regarding the study of this complex governance structure. These articles would be the last of the descriptive stage of cooperative analysis. For the next twenty years, agricultural economists introduced a stream of more rigorous neoclassical frameworks to inform the understanding of the agricultural cooperative. Bodies of theoretical work evolved around two structural design camps. First, the Robotka/Phillips school defined a cooperative as a collection of profit-maximizing economic enterprises engaged in economic activity involving the use of a common set of productive assets and interacting in Cournot-like fashion in response to individual sets of marginal cost and benefit relationships—in other words, a cooperative is an extension of the farm. The second school was initiated by the models of Helmberger and Hoos (1962). Their work identified the agricultural cooperative as an economic enterprise consisting of a production function, an efficiency-maximizing criterion, and a rule that distributes the economic surplus to the suppliers of one of the input resources. In their model the cooperative is a firm.

In his summary of the seminal study *Cooperative Theory: New Approaches* (Royer 1987), Staatz (1989) credits Emelianoff (1942), Robotka (1947), and Phillips (1953) as the original formal modelers viewing cooperatives as a form of vertical integration. They argue that the principle of "service at cost" implied that only cooperative members incurred profits or losses. Consequently each member determined her optimal level of output by equating the sum of the marginal costs in all plants (farm and cooperative) with the marginal revenue in the plant from which the product was marketed. The heroic Cournot–Nash assumption implied in the model, applied only to marketing cooperatives, is the major criticism of this "multi-plant firm modeling" approach. The cooperative-as-a-firm approach draws on Enke's (1945) work on consumer cooperatives. Enke's theory posits simply that the welfare of cooperative members and society is optimized if a cooperative maximizes the sum of the cooperative's producer surplus and the members' consumer surplus. This approach needs a hierarchical decision maker or coordinator—similar to the role assumed by the CEO or general manager of an investor-owned firm. The major criticism of this approach is that it does not lead to a stable equilibrium. In advancing this work, Helmberger and Hoos (1962) convert Enke's logic to explain marketing cooperatives' decision making. Based on the assumptions of a known net revenue function, price taking, and zero surplus objective function, the Helmberger–Hoos marketing concept of the cooperative as a firm suffers from the same equilibrium shortcomings as the Robotka/Phillips approach.

By the 1980s, economic theories and decision models designed to address more complex intra-firm relationships began to emerge. New

approaches such as agency theory, behavioral theories of the firm, incomplete contract theory, transaction cost economics, and property rights approaches allowed for more detailed investigation between inter- and intra-firm coordination decision making.

The following twenty years saw advances utilizing new institutional economic approaches by Fulton (2001), Cook (1995), Hendrikse and Veerman (2001), and Hendrikse and Bijman (2002), among others. Additionally, advances in neoclassical frameworks increased understanding of the role of cooperatives not only in remaining as a competitive yardstick but also in laying the groundwork for advances in the cooperative organizational design. Sexton (1990), building on the Helmberger–Hoos findings, used neoclassical theory to model spatial competition in agricultural marketing industries. The model derives price-output equilibria for investor-oriented firms and cooperative processors in oligopsonistic spatial markets focusing on the pro-competitive effects of cooperatives by formally establishing the conditions and magnitude of the cooperative yardstick effect in oligopsonistic markets. This work has interesting and controversial public policy implications. Its findings support favorable public policy toward open-membership cooperatives, but similar pro-competitive effects cannot be claimed for restricted membership cooperatives.

Contribution #2: Agricultural economists have played a key role in the development and design of institutions that are the foundation for agricultural credit markets

Surveys and analyses initiated early in the twentieth century on agricultural credit conditions and markets showed that "farmers were not being adequately supplied with capital for certain types of farm operations…. [T]he commercial banking machinery of the country was ill-adapted to making certain loans for the periods required by the farmer…, and the cost of farm loans was disproportionately high in comparison with the loans acquired for operating purposes in other industries" (Lee 1925, p. 425).

Congressional discussions and debate concerning the appropriate response to the problems identified by Lee included formation of cooperative or joint-stock banks, with an exclusive focus on agricultural loans, and the issuance of long-term bonds to finance amortized loans for the purchase of farmland and other capital assets. Legislation originating with the 1916 Federal Farm Loan Act and eventually culminating in the Farm Credit Act of 1933 formed the base for the current Farm Credit System (FCS), which today is a major supplier of credit to farmers, farmer cooperatives, and rural homeowners.

William I. Myers' role in the development of the FCS in its formative years is legendary; he served as governor of the Farm Credit Administration from 1933 to 1938. At the annual meetings of the American Farm Economic Association, he emphasized the cooperative nature of the system and that "generally speaking the Farm Credit System is not lending government money…. [I]ts object is to set up machinery through which farmers may obtain funds for financing their farm businesses from the investment markets at the lowest possible cost" (Myers 1934, p. 36).

Following the recovery of the agricultural sector from the Depression, the issue of the role of public credit institutions relative to private sector lenders became the focal point of the debate over the appropriate institutional structure of the agricultural credit markets. Benedict (1945) argued that commercial banks should be the principal source of short-term credit; the FCS lenders should be self-supporting and charge competitive but not-lower-than-market interest rates, since "[a]rtificially low interest rates on farm mortgages tend to be translated to high land values without long-term advantage either to the farmer or the public" (p. 103). Moreover, loans for emergencies must be evaluated by comparing the costs with the "social values resulting from the loans" (*ibid*). The result of this debate was the formation of the Farmers Home Administration (FmHA) in 1946 to provide supervised credit to farmers unable to obtain commercial credit. The farm lending activities of the FmHA expanded modestly during the 1950s and 60s (Herr 1969). Authorities were added in the 1970s to finance selected rural infrastructure such as housing, water supply, and waste disposal, as well as rural business and industrial development (Brake and Melchar 1970, p. 455). More recently these programs have been administered by the Farm Services Agency (FSA), with increased emphasis on guaranteed rather than direct loans and loans to beginning and socially disadvantaged farmers (Ahrendsen et al. 2005).

Farm sector debt increased significantly during the 1950s, 1960s, and 1970s. Declining incomes in the early 1980s, combined with the increased debt load, resulted in significant

debt service problems by the mid-80s. Jolly et al. (1985, p. 1114) indicated that based on data from the USDA Farm Costs and Returns Survey, "about 50% of farm operators and assets did not have a positive cash flow and that 64% of debt was not fully serviced in 1984." Much of the early debate about the appropriate response focused on how lending institutions and their farmer-borrowers might resolve debt-servicing problems and prevent foreclosures or bankruptcy filings. But as evidence began to mount that the problems were more serious than originally thought, the debate turned to the appropriate public sector response. Harl (1990) strongly advocated a public sector debt restructuring/principal write-down/federal guarantee program (p. 44). Passage of the Agricultural Credit Act of 1987 included (*a*) debt restructuring requirements for FCS (as well as FmHA) for debt in default, (*b*) an insurance program along the lines of the Federal Deposit Insurance Corporation and modifications to joint and several liability obligations of all FCS banks for system obligations, (*c*) and federal assistance to the FCS in the form of government loans to recapitalize FCS institutions experiencing financial problems. The system obtained $1.261 billion of U.S. Treasury guaranteed bond funds subsequent to this legislation and repaid the federal government (principal plus) interest in 2005.

Agricultural economists also contributed to the development of more efficient and effective capital and financial markets and institutions to serve the agricultural sector in developing countries. Adams, Graham, and von Pischke (1984) focused on the development of viable credit institutions for farmers to obtain financing for fertilizer, seed, and chemical purchases. In essence, their work indicated that government/state-owned financial institutions frequently encountered long-term viability problems, in large part because of the political pressure to forgive loan obligations of borrowers in default. They were also critical of the common policy of government-run financial institutions of charging below-market interest rates, argued that informal lenders often provided more valuable services than is generally perceived, and suggested that financial institutions in developing countries should emphasize mobilization of local savings as a key source of funds rather than relying on international funding agencies such as the World Bank and the International Monetary Fund.

Contribution #3: Agribusiness scholars utilizing interdisciplinary approaches and new economic frameworks have become instrumental in diagnosing and understanding the incentives/disincentives embedded in agribusiness organizational architecture and complementary networks

A graph of our profession's interest in organizational design of agribusiness enterprises might look like a U-shaped curve. In the early days of the profession, agricultural economists offered many thoughtful observations about the recommended or optimal form that agricultural trade organizations, processing firms, and agricultural cooperatives might take. Their insights into aligning residual claim and residual control rights and efficient allocation of incentive-driven decision authority were utilized as benchmarking tools for organizers of said entities (Jesness 1925). But as formal modeling advanced utilizing neoclassical economic theories which tentatively treated the firm as a "black box," additional work on organizational design did not appear until more intra-firm incentive models came into practice beginning in the late 1980s.

By the mid-1990s numerous conceptual pieces, including those of Moore and Noel (1995), Fulton (1995), Hind (1994), Chaddad and Cook (2004) and Hendrikse and Veerman (2001), began to appear in the *American Journal of Agricultural Economics* and related journals. Empirical pieces soon followed. For example, Holland and King (2004) and Detre, Wilson, and Gray (2007) explored why producer-owned hybrids which are more investor driven than previous patron-driven forms of collective action were increasing as an organizational form favored by agricultural producers. Examination of the Hendrikse and Bijman (2002) analysis expands on these conceptual advances as producers address complex governance structure choices. Their approach analyzes the impact of ownership and control structure on investments in a multiple tier net chain utilizing a property rights–incomplete contract framework. They continue the quest to determine under what market and incentive structures it is beneficial for producers to integrate downstream through their own investment. Employing game-theoretic models and analyzing scenarios with distribution of bargaining power as the variant, the authors generate first-best efficient ownership structures given alternate investment situations. Using comparative

statics with the incorporation of residual claim levels, optimal ownership structures are derived. The contribution of the incomplete contract approach to governance structure choices is evident. Attempting to advance understanding and utilization of these deductively generated set of hypotheses, Chaddad and Cook (2004) identify a typology of discrete organizational models ranging from traditional open-membership cooperatives described and analyzed by the first generation of agricultural economists to complex hybrids to investor-owned organizational forms. Their ownership rights typology challenges the next generation of agribusiness scholars studying the performance of food and agribusiness net chains and their participants. Organizational design studies continue to diminish the concept of the cooperative as a black box.

Contribution #4: Agricultural economists have documented, developed, and applied theories to explain changes in market structure and performance in the food system

The structure and performance of the processing, distribution, and retailing segments of the food system have been a focus of inquiry since the early days of our association. In a paper presented at the 1922 annual meeting, Price (1923, p. 129) noted that marketing systems could be studied from the perspective of "inter-unit" or "intra-unit" organization. The former focuses on the number of intermediary firms between the farm and the consumer and the economic relationships among these firms. The latter focuses on the internal organization of marketing businesses.[1] Price focused on intra-unit organization, presenting operating cost information for butter plants and grocery stores. There was also much interest in inter-unit organization. For example, in 1930 an annual meeting session organized by Miller (1930) examined the evolving structure of the food distribution system. Several years later Waugh (1934) published his important paper on "Margins in Marketing," which presented estimates of farm–retail price spreads and outlined key issues for future research on marketing margins.

In 1940, A. C. Hoffman (1940) began a paper on the "Changing Structure of Agricultural Markets" by noting:

> It is probably correct to say that the organization of agricultural markets has changed more in the last 25 years than during the preceding century…. From a system comprised almost wholly of small, functionally specialized business enterprises there has been a transition to vertically integrated concerns operating on a regional and even a national basis. (p. 162)

Hoffman described the emergence of mass retailing and the then-recent appearance of the supermarket. He went on to discuss size economies, the limits of management control in large organizations, vertical integration, and the problems created by monopoly power in food retailing. He also observed that forces leading to consolidation and market power in retailing were also likely to be seen in food manufacturing. In that same issue of the *Journal*, William H. Nicholls (1940) published "Market-Sharing in the Packing Industry," another foundational paper on industrial organization of the food system. Nicholls drew on recently developed theories of imperfect competition to explain how observed patterns in packers' purchase shares in terminal markets were consistent with collusion that would likely harm farmers and consumers.

The trends identified by Hoffman (1940) continued over the next several decades, prompting establishment of the National Commission on Food Marketing in the 1960s (Brandow 1966), lively debates on the structure of the food system during the 1970s, and the establishment of NC-117, "Organization and Control of the U.S. Food Production and Distribution System." This remarkable project brought together a strong team of researchers who combined insights from emerging theories in the field of industrial organization with careful observation, data collection, and empirical analysis to investigate the structure of the food system, the forces driving change in the structure, the effects of alternative laws and regulations on that system, and the consequences of alternative public policies and private actions on its performance. An article by Shaffer (1980) explores the conceptual framework for the project's efforts, and many key findings of NC-117 are summarized in three widely cited books: *The Food Manufacturing Industries* (Connor et al. 1985), *The Organization and Performance of the U.S.*

[1] This is a distinction not unlike that between agribusiness economics and agribusiness management made nearly eight decades later by Cook and Chaddad (2000).

Food System (Marion and NC-117 Committee 1986), and *Food Processing* (Connor 1988). This work has been the foundation for more recent research on antitrust issues (e.g., Connor 2001), pricing policies (e.g., Cotterill, Putsis, and Dhar 2000), and generic advertising (e.g., Kaiser et al. 2005).

During the latter twenty years of the twentieth-century globalization, industrialization and consolidations accelerated changes in the horizontal and vertical relationships between participants of the global food and fiber system. Many of the organizational and transactional arrangements that emerged during this period addressed the increasingly strategic nature of the market structure and growing strategic interdependence between chain and network rivals and partners. Agribusiness economics and management scholars seeking outlets for new conceptual frameworks, methodologies, and insights, as well as more interdisciplinary-friendly outlets, helped establish a plethora of new journals, including *Agribusiness*; *International Food and Agribusiness Management Review*; the *Journal of Agricultural & Food Industrial Organization*; the *Journal of Cooperatives*; the *Journal of Agribusiness*; the *Journal of Chain and Network Science*; and the *Journal of Supply Chain Management*. Perusal of the special editions of these journals (on topics such as eco-labeling, food retailer strategies, food vs. fuel, the hybridization of cooperative organizational forms) demonstrates the complexity and expansion of the original issues identified in this subfield of agribusiness economics and management.

Contribution #5: Agricultural and applied economists have focused attention on key economic questions related to supply chain management and design

A supply chain or value chain, as defined by Boehlje (1999, p. 1032), is a set "of value creating activities in the production-distribution process and the explicit structure of linkages among these activities or processes." The fundamental question in supply chain design and management is that of how a chain can most effectively deliver quality and value to consumers. The focus is on systemwide performance with an emphasis on information flows and coordination mechanisms. The terms "value chain" and "supply chain" first appeared in publications of the American Agricultural Economics Association (AAEA) in 1987 and 1995, respectively, but agricultural and applied economists were doing significant work on the economics of supply chains long beforehand by posing questions that have advanced the study of supply chains well beyond the simple description of linked production–distribution activities and processes.

One fundamental concern in supply chain research is how flows of product, information, and financial resources through the chain can best be governed. Building on transaction cost concepts developed by Coase (1937) and Williamson (1975), Sporleder (1992) examined the determinants of vertical coordination arrangements, giving particular attention to strategic alliances. Several years later, Hobbs (1996) presented a more thorough overview of transaction cost economics and outlined methodological approaches for studying vertical coordination, including multi-industry evaluations using secondary data, industry-specific investigations of transaction costs using secondary data, and industry-specific investigations of transaction costs using primary data.

Inter-firm incentives are also a key concern in supply chain design. Embodied in formal or informal contracts, these systems help align incentives and reduce losses induced by information asymmetries. Contract design became an important focus for work in the mid-1990s, at a time when first handlers and processors were expanding the use of contracts with farm producers and were experimenting with a variety of new contract forms. Knoeber and Thurman's (1995) work shed light on the risk-shifting role of relative performance-based contracts in the broiler industry and offered important insights on methods for empirical analysis of contract provisions. Sheldon's (1996) review paper provided an important overview of contract theory and helped set the stage for later work such as that by Goodhue (2000) on production contracts and by Hueth and Ligon (2001) on relative performance contracts in the produce sector.

The distribution of revenues, costs, and gains from improved system performance among supply chain participants is another key issue in supply chain design and management. Marketing margins were a subject of concern and debate in the 1930s (Waugh 1934) as the farm share of consumer food expenditures continued to shrink. Work at that time was largely descriptive, but forty years

later Gardner (1975) developed a model of simultaneous equilibrium in the markets for retail food, farm products, and marketing services. That model motivated later work on price transmission by Wohlgenant (1989) and others—research that can have important implications for supply chain design. More recently, in a very different analytical framework, Hendrikse and Bijman (2002) showed how the allocation of ownership of essential assets affects the distribution of returns across the chain and investments that affect overall productivity.

Finally, members of our profession have also asked how public and private sector institutional mechanisms—such as product and process quality standards or regulations—shape supply chain performance. Caswell, Bredahl, and Hooker's (1998) paper on qualitative management metasystems laid the foundation for work on this question. Food quality metasystems are general strategies, such as ISO 9000 and "just in time" logistics, that are broadly applied across supply chains and across firms within a supply chain. Caswell, Bredahl, and Hooker (1998) note that the development of quality metasystems, whether through the public or private sector initiatives, can stimulate structural change and influence competitiveness. Subsequent work—e.g., by Starbird (2005) on sampling inspection and by Carriquiry and Babcock (2007) on the reputational effects of quality assurance systems—has confirmed the importance of quality metasystems.

Research on these important economic questions related to supply chain design and management has been and will continue to be crucial in developing our ability to meet the critical need that Boehlje (1999) identifies for *ex ante* rather than *ex post* analyses of structural change in the food system. It contributes significantly to our ability to support both agribusiness economics and agribusiness management.

Agribusiness Management

Agribusiness management is concerned with decision making within the organizations that comprise the food system. This section describes four areas in which members of our profession have contributed significantly to understanding and supporting operational, financial, and strategic decisions in agribusiness firms.

Contribution #6: Agricultural economists have created robust methods and tools that foster more efficient operations within the agribusiness sector

Transforming agricultural commodities into food products typically requires conversion of large amounts of lower-value materials into more valuable products and transport (of agricultural inputs and food product outputs) over considerable distances. To address this economic challenge, managers need to be able to assess both cost of production alternatives within a single production facility as well as the total cost-effectiveness of locating several facilities across a region. A similar challenge exists in terms of designing the most effective production and transportation system to provide inputs to farm production operations. Greater operational efficiency results in higher performance levels for agribusiness firms and enhances social welfare through lower food costs and higher-quality food products.

Over the last 100 years, application of microeconomic principles along with use of evolving quantitative analytical tools has provided significant opportunity for innovation throughout the agribusiness sector. Especially in the middle decades of the 1900s, agricultural economists led both intellectually and in application of these capabilities to enhance operational efficiency of supply, processing, and distribution in the sector.

In the 1940s, the economic engineering approach to estimation of plant cost relationships began to be employed to address the more managerially relevant question of optimal plant size for a specific commodity and setting. The work of R. G. Bressler and numerous colleagues made a particularly profound contribution to application of the economic engineering approach in the food sector. Early work focused on Connecticut and the dairy industry (Bressler 1952), while numerous later efforts were conducted at the University of California. The economic engineering approach focused on synthesizing cost functions from engineering, biological, and other sources of information, including accounting data, based upon process level input-output relationships.

Although an individual food manufacturing facility might achieve exceptional internal efficiency, the overall economic performance of that unit can be materially affected by the costs of obtaining agricultural inputs and of distributing the factory's output. As food

manufacturing firms are likely to have several production facilities, the firm's managers need to be able to optimize a system of facilities.

One of the first rigorous efforts to address this challenge was detailed in Stollsteimer's (1963) article focused on assessing plant numbers, size, and location for pear production and processing in California. He developed a modeling specification consistent with the challenge of minimizing the combined cost of assembling and processing agricultural commodities. Essentially an extension of the basic linear programming transportation model, Stollsteimer's work included plant numbers and locations as internal variables and allowed for economies of size. Over time, this basic approach was extended to more accurately reflect the circumstances of alternative agricultural commodities and the actual dynamics of the marketplace. For example, Polopolus (1965) examined multiple-product plants, and Ladd and Halvorson (1970) developed means to assess the sensitivity of model results.

The post–World War II period saw an explosion of activity relating to the study of operational efficiency in the agribusiness sector. This marked increase in academic productivity was the joint result of interacting forces such as changing societal needs, advances in theory and computational capabilities, and the infusion of federal funding targeted to agricultural marketing. French's (1977) review article interpreted the vast array of literature produced in that time period. In addition to comprehensively documenting the productivity of prior works, this effort undertook an extensive and thorough interpretation of the challenges and accomplishments of the stream of work relating to productive efficiency in agricultural marketing. It thus provided the single reference point for legions of researchers, instructors, and students working in this area.

Agricultural economists have continued to provide empirical assessments focused on enhancing efficiency within individual processing facilities and among systems of facilities. As computational capabilities and modeling methods have advanced, these innovations have been incorporated within increasing sophisticated studies to inform decision makers. Akridge's (1989) analysis of multiple-product fertilizer retailing plants employed a frontier multiproduct cost function to measure productive efficiency. The potential for significant reductions in variable costs was identified. Starbird's (1990) assessment of tomato processing plant efficiency adopted a novel approach to estimation of response surface identification. A cost-function metamodel is successfully applied to estimated factor-demand equations, resulting in reduced specification error. A bootstrapping regression approach was employed by Schroeder (1992) to separately identify the extent of scale and scope economies for a sample of supply and marketing cooperatives. Distinguishing between these types of potential economies provides relevant decision-making information for agribusiness managers. These studies demonstrate the continuing commitment of agricultural economists to identify means for measuring and enhancing productive efficiency in agribusiness operations.

Contribution #7: Agricultural economists have developed financing instruments and arrangements tailored to the characteristics of the farm sector; loan portfolio, credit analysis, and capitalization structures for financial institutions serving the sector; and valuable public data resources on sector and firm financial structure and performance

Early work in agricultural finance focused primarily on how effectively lenders were serving their farm customers in terms of loan terms, interest rates, and credit standards and in general adequately fulfilling and responding to farmers' credit needs. Black (1930) argued that "information should be uncovered to permit him [the farmer] to learn to use credit intelligently, to control credit instead of being controlled by it" (p. 249). This focus on credit use dominated not only the research agenda, but also data collection, outreach activities of the USDA and Land Grant System, and widely used textbooks such as Murray's (1941) early editions of *Agricultural Finance*. Development of amortization concepts, matching repayment terms to income/earnings capacity and viewing credit as a resource that could be used (i.e. converted into debt) or held in reserve to manage potential financial stress (Barry and Baker 1971), was the focus through the 1970s. It was not until the work on farm firm growth models (Baker 1968; Boehlje and Eisgruber 1972) that capital allocation and investment decisions were added to the agenda. The focus returned to appropriate use of credit and more accurate measurement and documentation of the financial performance of farm firms in the 1980s through the work of the Farm Financial Standards Council (1991).

During the 1970s the structural changes in the financial markets and the pressures for consolidation of the institutions in both the commercial banking sector and the FCS stimulated work on the cost and efficiency of the consolidated/restructured financial institutions, and the effectiveness and commitment of these generally larger and less locally controlled/owned institutions to serve the farm sector and rural communities. Such work is summarized by Ellinger, Hartarska, and Wilson (2005) and Gustafson, Pederson, and Gloy (2005). Beginning in the 1990s, attention shifted to issues of capital structure, loan and asset portfolio composition, and credit risk management of the financial institutions serving agriculture. This work was stimulated in part by the bank and FCS failures of the 1980s combined with the deregulation of the financial markets, which placed more burdens on the individual institution to manage its financial risk in an increasingly competitive market. Notable work on these issues is summarized by Gustafson, Pederson, and Gloy (2005).

Additionally, a mainstay of the agricultural finance work since its early years has been the collection and analysis of financial data. This work started with the farm records/farm accounts programs of Warren and colleagues at Cornell that were an integral part of their farm management programs. It continues today in the form of farm records programs and activities of both the Land Grant System and the private sector.

Data in the form of descriptive statistics for both the farming sector and the financial institutions serving that sector, which were the focal point of work by the USDA under the leadership of Garlock (1966) and Tostlebe (1957), were used to characterize the changing financial condition of agriculture early in the twentieth century. Extension of this work resulted in the USDA's first publication of the sectorwide *Balance Sheet of Agriculture* and *Farm Income Situation* in 1940.These data sets continue to be developed today. The Federal Reserve System initiated surveys of farm lenders and their lending activity late in the 1940s. Melichar (1979) and colleagues issued their first *Agricultural Finance Data* book in 1976, which continues today to be an extensive and exhaustive data set summarizing the changing financial characteristics of farm borrowers and lenders. The USDA implemented an annual Farm Cost and Returns Survey in 1991, which is a forerunner to the current Agricultural Resource Management Systems (ARMS) data set. In more recent times, additional data on the financial and resource characteristics of the farm family, including labor allocation, nonfarm income, and investments and family expenditures, have been collected as part of this survey. As with the earlier survey work of the Federal Reserve Banks, the ARMS data set has been used extensively by the USDA and Land Grant agricultural economists in their research programs. The extensive financial data collected and the numerous analyses that these data have supported document that although the agricultural sector and farm businesses were characterized by low incomes and weak financial performance earlier in the twentieth century, in recent times that performance has become more competitive with other industries.

Contribution #8: Agricultural economics scholarship has informed business strategy formation by monitoring, interpreting, and anticipating the changing business environment of agriculture

Business strategy focuses on optimizing the linkages between the firm and its surrounding business environment (Porter 1985). This managerial function inherently incorporates a longer-run perspective, striving to ensure that the firm not only is well aligned with current conditions but also is being positioned to adapt to the dynamic and uncertain business environment of tomorrow. A key element of strategy can be paraphrased as a "how will we compete" question (Aaker 1988). Business management concepts such as competitive advantage, distinctive competencies, and the resource-based view of strategy have been intertwined in the scholarship addressing this question, especially during the last three decades.

Understanding how to compete within the context of a dynamic agricultural sector and an evolving global economy is a key challenge for agribusiness decision makers. Throughout the last 100 years, the scholarship of agricultural economists has contributed to improving decision-maker understanding of the business environment of agriculture.

In addition to his seminal work with Davis, Goldberg pioneered in employing the case study method within agribusiness. He utilized this form of scholarship to uncover relationships and to communicate the dynamics of change to legions of decision makers. The more than 300 Harvard Business School case studies he has coauthored address a vast array of factors affecting global agriculture. The

Agribusiness Seminar he has led also has been a powerfully effective means of educating agribusiness managers.

Key empirical work, especially from the 1950s to the 1980s, focused on providing an enhanced, quantitative understanding of the evolving production agriculture sector. These developments were critically important as the size and scope of input supply and commodity marketing firms are inherently connected to the regional nature of agricultural production. As the underlying technologies supporting production agriculture evolved, the dynamics of regional production underwent considerable change.

The development of mathematical programming allowed for detailed analysis of interregional competition in a "systematic and manageable way" (Jenson 1977, p. 47). From the 1950s into the 1980s, Heady and others at Iowa State University developed a series of increasingly sophisticated mathematical models focused on the dynamics of interregional competition. A primary building block for those analyses, and for others conducted throughout the profession, was described in USDA Technical Bulletin 1241, *Regional Adjustments in Grain Production: A Linear Programming Analysis* (Egbert and Heady 1963). That work was initiated in 1955, as soon as the 1954 Census of Agriculture was available. Grain production (shifts in location, resource use, and output levels) was the primary focus of this pioneering work. The direct output was explicit definition of comparative regional production efficiencies, as well as optimal production patterns, associated land rents, and prices for feed grains and wheat. Based on that pioneer effort, numerous extensions and advancements were completed over the following decades.

Although technical change has been a constant driving force within agriculture, the 1980s saw an intense interest in the potential for biotechnology and information technology to profoundly alter agricultural systems, in concert with other structural and financial challenges occurring in the sector. There was an urgent need for comprehensive analyses of these interlinkages. One effort which accomplished that goal was published as *Technology, Public Policy, and the Changing Structure of American Agriculture* (US Congress 1986). Employing a mix of published research and qualitative methods, this assessment specified scenarios of change for the agricultural sector, and it advanced policy prescriptions focused on the future structure of the sector.

More recently, the methods of agricultural economists have advanced along with the general management literature and the nature of change in the sector. As a result, the scholarly capabilities of agricultural economists have been directly applied to decision-making issues within agribusinesses. These efforts have necessarily required explicit consideration of the manager as more than only a strictly rational, economic being (Mintzberg 1978).

An article by Fisher, Sonka, and Westgren (2004) sets a standard for work that contributes to professional scholarship while investigating strategically important issues with actual decision makers. It reports on an intervention where sophisticated information technology tools (animated, three-dimensional visualization techniques driven by estimates from a system dynamics simulation model) were used to help managers assess future options and chart strategic directions. Focused on potential scenarios for global protein needs, the article's more significant contribution was in empirically documenting the effect of the use of visualization techniques and economic modeling on strategic thinking. In addition to its research impact, this work was used in executive education programs for numerous decision makers from throughout the global soybean industry.

Contribution #9: Educational programs in agribusiness have developed human capital that has contributed significantly to productivity growth in the food system

Educational programs have been a central concern for our profession over the past century. Long before the term "agribusiness" was introduced, the key role of business education in our undergraduate and graduate programs was clearly recognized. For example, in a presentation at the 1926 annual meeting of our association, Buechel (1927) discussed the importance of business education and expressed concerns that business administration programs might draw students away from programs offered by agricultural economics departments. Twenty years later, Wood (1947) reported results of a survey of potential employers for graduates from Purdue's agricultural business program and described a suggested curriculum designed to meet the needs identified by potential employers. Several years later, John D. Black, who would soon be joined at Harvard

by John Davis and Ray Goldberg, reported on findings from a survey of the profession on the role of economics in undergraduate curricula. Black (1953) concluded that

> departments of agricultural economics in the larger colleges at least should consider offering three curricula, one of the general-agriculture type to serve especially the needs of future farmers and extension workers, one in agricultural business to serve the needs of young men looking forward to a career in businesses serving farmers, and one to prepare agricultural economic specialists. (p. 491)

He went on to note that the agricultural business curricula would often rely on coursework in undergraduate business colleges.

Stimulated by growing interest in agribusiness within the profession and by growing demand from rapidly expanding agribusiness firms, agricultural business programs continued to develop and evolve in the 1960s and 1970s. There were tensions as members of the profession developed stronger ties with the broader agribusiness sector. A. C. Hoffman, vice president of Kraft Foods Company, criticized existing undergraduate programs for their emphasis on economics. He stressed that "the agribusiness economist should be trained not only in economics but also for general business management" and went on to note that traditional agricultural economics programs were not "adequate for this purpose" (Hoffman 1969, p. 449). Discussants responding to Hoffman's paper acknowledged problems but also emphasized positive accomplishments and changes under way at many universities.

Part 2 of the November 1973 issue of the *American Journal of Agricultural Economics* was devoted to papers presented at a workshop on the Improvement of Education in Agricultural Economics by Defining Goals, Developing Curricula, and Improving Instruction. This issue includes descriptions of undergraduate curricula at the University of California–Davis (Parker 1973), Southern Illinois University (Wills 1973), Michigan State University (Connor 1973), and Texas A&M University (Grady 1973). The curriculum at each institution except Southern Illinois University included some form of agribusiness track or concentration, and Wills noted that the lack of this option at his university was due to budget restraints. There was great diversity in the structure of agribusiness programs at that time, reflecting historical and contextual differences as well as the recognition that there was value in experimenting with new models.

Graduate and professional programs in agribusiness were somewhat slower to develop. Litzenberg, Gorman, and Schneider (1983) identified four existing professional graduate programs and two under development. In 1989 the National Agribusiness Education Commission was organized "(a) to develop guidelines for a masters degree in agribusiness management, (b) to suggest strategies for continuing education and executive development courses for employees, and (c) to recommend steps to cultivate faculty resources in agribusiness education" (Woolverton and Downey 1999, p. 1050). Woolverton and Downey reported that relatively little progress had been made in the decade following the commission's report. They went on to note (p. 1055) that the need for well-trained agribusiness managers might be met by "continued expansion of undergraduate programs in agribusiness management coupled with five to six top-quality agribusiness MBA and continuing education programs."

In 2002 the USDA provided funding for the National Food and Agribusiness Management Education Commission to assess the current state of agribusiness management education and develop recommendations for addressing key issues that face these programs. The commission's 2006 report (Boland and Akridge 2006) presents specific recommendations in six key areas: (1) curriculum assessment and revision, (2) communication/writing/critical thinking skills, (3) industry linkages, (4) student recruitment for food and agribusiness management programs, (5) introductory and capstone undergraduate courses, and (6) graduate programs in food and agribusiness management. These recommendations will be a roadmap for campus-based agribusiness education as our profession enters its second century.

Finally, our educational impact extends beyond campus-based programs to include direct involvement with agribusiness decision makers. The Agribusiness Seminar at the Harvard Business School has long been recognized for its important contributions. Other noteworthy programs include the Center for Agricultural Business at Purdue University, the Executive Development Program of the George Morris Centre in Canada, the Executive Program for Agricultural Producers at Texas A&M University, the Food and

Agricultural Policy Research Institute at the University of Missouri–Columbia and at Iowa State University, and the Graduate Institute of Cooperative Leadership at the University of Missouri–Columbia. These and other programs have been exemplary in their ability to integrate research scholarship and outreach to advance strategic decision making in the agribusiness sector.

Opportunities and Challenges for the Future

Our association's first century was a period of unprecedented change in food production, distribution, and consumption. The following are forces for future change.

- The agricultural sector is increasingly a source of raw materials for sectors outside of the traditional food and fiber system. Agricultural products are being used to produce biofuels, industrial products such as polymers and bio-based synthetic chemicals and fibers, and pharmaceutical/health products such as functional foods, growth hormones, and organ transplants. This is blurring industry boundaries and creating new strategic and competitive challenges for agribusiness firms, and it will have profound implications for the structure and operations of the supply chains in the industry.
- Agribusiness organizations are becoming more flexible and complex, more decentralized and yet reliant on collective action and cohesiveness. This poses challenges for managers designing the incentive systems and internal institutions that are the foundation for intra-firm structure, strategy, and governance. At the same time, technological change and the emergence of new globalization–localization tensions will stimulate changes in socioeconomic relationships, reshape scope and scale economies, increase risks, introduce new and novel interdependencies, give birth to new rivals and potential partners, and mold more hybrid organizational forms. This will complicate inter-firm coordination for agribusiness managers and food system policymakers.
- With the approach of peak world oil production, the prospect for international agreements to reduce greenhouse gas emissions, and the potential for significant geographic shifts in food production patterns due to climate change, there are likely to be large shifts in relative prices over the next quarter century. This could trigger an unpredictable, radical restructuring of the food system and critical strategic positioning issues for agribusiness firms.

Understanding and anticipating the dynamics of the global agribusiness environment will be increasingly critical. These challenges—along with advances in theoretical frameworks, diagnostic tools, and empirical techniques for addressing them—will afford agribusiness scholars an ample supply of issues, approaches, and motives to expand and broaden inquiry into an ever-increasing complex and important global food system. They will also offer us new opportunities to help students, managers, and policymakers through agribusiness teaching and outreach programs. While economics will continue to be the foundation for our work, concepts from other social science disciplines and sophisticated new computational tools also will be necessary.

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