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Post-Industrial Agriculture

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The "industrialization of agriculture" has become a catch-all phrase to describe a set of changes occurring in agriculture during the 1990s (for example, see Boehlje and Drabenstott). We, however, contend that the current changes result mainly from post-industrial factors rather than from industrialization. Viewing the current changes in agriculture through the prism of post-industrialization rather than through the prism of industrialization leads to a richer understanding of the emerging economic and social trends within the sector. After briefly stating our case for a post-industrial perspective, we highlight some key economic and social implications.

INDUSTRIALIZATION VS. POST-INDUSTRIALIZATION IN AGRICULTURE

Industrialization is closely related to "Fordism," referring to large scale mass production of homogeneous products for a mass market (Kenny et al., p. 135). Agribusiness input supply and marketing sector firms, as well as crop and livestock farms, are indeed becoming larger. They also use or are adopting the key industrial manufacturing concepts of systemization, routinization, and specialization (Boehlje). However, bigness is not a *prima facie* argument for industrialization. Precision farming characterized by site-specific input application and by niche-

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market specific output is more the mark of an information-based post-industrial economy than a routinized industrial economy.

The term "post-industrial" traces to Daniel Bell's 1973 book *The Coming of the Post-Industrial Society: A Venture in Social Forecasting.* Bell (p. 127) noted the rise of service industries and argued that "The critical person is the professional, for he [she] is equipped, by his [her] education and training, to provide the kinds of skills which are increasingly demanded in the post-industrial society." Delauney and Gadrey expressed a similar view when they observed (pp. 88, 89) that knowledge is the essence of post-industrial society and that "scientific knowledge, the basis for innovation, becomes the ultimate strategic resource." Thus, the literature identifies a post-industrial economy as a knowledge-based economy. The pursuit of knowledge revolves around the acquisition, evaluation, and integration of information. The literature also identifies a post-industrial economy with a service economy—services account for approximately 75 percent of all jobs and 90 percent of new jobs in the United States. Farmers and other agribusiness managers are spending more time with post-industrial service activities, such as information gathering and processing, marketing, management, risk strategies, and finance, relative to time spent on production activities.

Given this perspective, our argument for a post-industrial view of agriculture traces to the seminal work of T.W. Schultz and his disciples. They recognized that the massive productivity gains in farm output which began in the 1930s were due to the nonconventional or knowledge inputs of education, research, and extension. These nonconventional inputs were embodied in new inputs such as hybrid seeds, as well as in traditional inputs such as fertilizer and mechanical

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implements. In fact, agriculture was one of the first post-industrial sectors: scientific principles, often generated by Land Grant Universities, formed the basis of a new agriculture.

To illustrate the impact of these nonconventional inputs, in 1996 the U.S. harvested 9.3 billion bushels of corn from 73.1 million acres. To produce that output using the technology of the 1920s, 346 million acres would be needed, or almost as much total cropland as the U.S. harvested in 1996. This increased production did not come about because of systemization, routinization, and specialization of 1920s technology, but because science created and applied knowledge to form new technologies. Furthermore, the farms and agribusinesses who survived and prospered were those who excelled at acquiring, evaluating, and adopting these new technologies and their imbedded information.

IMPLICATIONS

1. Knowledge (information) acquisition, generation, and management are difficult to mechanize and require personal attention. Historically, productivity gains in these areas have been limited. Agricultural research and extension output has had a high payoff to society, but the output of services per scientist probably has increased very slowly. Education also has had a high payoff to society, but the output of each teacher or professor has increased slowly. Given the growing importance of information, productivity growth in information generation and management will need to improve in order for overall productivity growth to improve.
2. Some methodological problems plaguing measurement of productivity gains in information management have been surmounted, but the contributions to productivity of a major technological revolution, the computer, remain difficult to measure. Managers will spend

much time trying to develop new and better measures of productivity in information management.

3. For farmers and other small business operators, information management competes for time working in the field or on the shop floor. Complete reliance on self provision of information management will restrict the firm to a modest-size production unit too small to realize economies of size and a satisfactory living for the operator and family. On the other hand, ability to allocate time properly among production activities and the varied finance, real estate, tax, management, risk strategies, and other information and knowledge intensive services will be critical to the firm's economic vitality.

4. Many agribusiness managers will suffer information overload. T. W. Schultz some years ago noted the importance of farm operators being able to process information to manage disequilibrium. The generation of new information is accelerating (Zulauf and Meir). Each new piece of information is a double-edged sword: it can help manage an existing disequilibrium, but can also potentially cause a new one.

5. Besides being an outgrowth of the need to manage information overload, the growth in the use of information management services also reflects the need for and advantages of the division of labor described by Adam Smith. The specialization of labor and the associated hiring of services enhances the opportunities for economies of scale to capture the full effect of unique abilities and to spread the fixed cost of hired services. The forces for change in a post-industrial economy will make for fewer and larger firms in a given market activity, but a richer array of firms engaging in a wider array of activities. More consultants will join those already meeting the demand for services from farmers and other agribusiness managers. Valuation of the benefits and costs of these hired services will become an

important management function. Another emerging trend is that more family farms are operating as partnerships: e.g., one individual responsible for marketing, another for livestock, another for crop technology, another for financial records and arrangements, another for machinery, and another for strategic planning. In contrast, opportunities for small farms to be economically viable without off-farm earnings will narrow.

6. The increasing importance of information and information management has caused some input suppliers, marketing firms, and cooperatives to supply some of producers' information needs for no or nominal direct charges as an enticement to use their product. This trend will grow in importance, and presents an alternative source of advice to extension agents and consultants.

7. Another avenue for the management of information overload is vertical coordination, especially production contracts and integrated ownership. Producers and growers enter into production contracts partly to reduce capital requirements, but also to gain access to veterinary, marketing, and organizational management services. Integrators gain economies of size and control over the production process and its end products. Producers gain access to information because economies of size and scope make its acquisition more affordable. However, even integrated operations will turn to consultants from time to time.

8. The increasingly pivotal role of knowledge and the key role of science will shift more research in agriculture to the private sector. Land Grant Universities will have a tougher time competing for and justifying public dollars for agricultural research. This trend also will hold for basic research because it provides the foundation for future market products of firms. Land Grant Universities will perform more research paid for and utilized by private firms, raising issues of conflict of interest and crowding out of public basic research.

9. Although private firms will play a greater role in the future in providing information services, a shortcoming is that some information services fail the test of being a market "good" (rival, exclusionary, and transparent). Where information services are non-exclusionary, users can easily acquire the service at little-to-no cost. Hence, private firms cannot earn enough receipts to cover their costs. These information services will be under-provided by private firms, despite potentially large social benefits. Patents and copyrights can internalize enough benefits to turn public into private services in some cases; however, many of these information services will be candidates for public provision.

10. Asymmetric information is a potential problem for users of information services. Users may only belatedly discover that information sellers have peddled unreliable data. The evaluation of the accuracy of private information sources is a potentially important future activity for the Cooperative Extension System, a service it already provides in many states through varietal seed trials. Taken together, points 8 through 10 underscore that the search for the optimal mix of non-profit and for-profit private, cooperative, and public institutions to provide needed information services will remain a challenge.

11. A growth industry is likely to develop out of the need to sort worthwhile knowledge from the bewildering flood of information available on the internet and elsewhere. Computer-based expert systems that can handle large amounts of information will grow in importance. Such systems are already available to lawyers and doctors. Existing tax software is a low-level example of expert systems for businesses.

12. The growing importance of information-management will give women an increasing role in post-industrial farming. Women are prominent in many information-service industries.

Activities such as operating computers, keeping financial records, and developing and following marketing plans increasingly place women in farm management roles.

13. While many research and extension activities will migrate to the private sector, universities will continue to remain key centers of education, especially for young adults. Universities are recognizing the need to train students for a post-industrial agriculture dominated by service occupations and activities. Few students are graduating without being computer literate. More of our agribusiness classes at The Ohio State University are using textbooks from general business rather than from agricultural production business, enabling students to perform service activities over a broad range of industries. The fact that more and more "agricultural" economics departments are naming themselves applied, resource, or agribusiness economics signals the growing importance of service sub-disciplines relative to production agriculture in our interdisciplinary field.

14. Agribusiness and applied economics departments have a unique opportunity to provide future agribusiness operators, managers, and workers with the finest information skills available to perform tasks essential to the vitality of post-industrial farms and agribusiness firms in the 21st century. The greater focus on acquiring the information-centered skills characteristic of a post-industrial economy rather than the production skills of an industrial economy will distinguish 21st from 20th century agriculture. Nonetheless, production skills cannot be ignored—that is why colleges of business are less qualified than colleges of food, agriculture, and natural resources to serve the needs of post-industrial agriculture.

We end this discussion by noting that taxonomies, such as industrial and post-industrial, are always inaccurate because vestiges of both systems coexist together. An example is the

continued production of homogenous products by farmers (an industrial trait) while new inputs generated by research (a post-industrial trait) drive change at the farm level. On the other hand, taxonomies are important to the extent that they describe key attributes of the current and emerging situation. At present, the destiny of agriculture rests with managers who will spend much of their time pursuing knowledge by first acquiring, then evaluating, and, eventually, integrating information into their business operations. Mastery of this knowledge process will mean the difference between firm success and failure.

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