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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The Pay-Off of Precision Farming

Precision farming has the potential to have profound impacts on the agricultural production/distribution system. What are these impacts, or more to the point, what is the payoff of precision farming?

1. **Cost Reduction/Efficiency Increases** - The improved measurement of soil characteristics and weather patterns that is part of precision farming has the most direct and obvious payoff in terms of cost reductions and efficiency increases from more accurate use of inputs such as fertilizer, seed, chemicals and other inputs and the systematic measurement of the impacts of these inputs on yield and profitability. In essence, precision farming is one step closer to the manufacturing mentality of production agriculture. Precision farming combined with creative ways to schedule and sequence machinery use including 24 hour-per-day operations, moving equipment among sites and deployment based on weather patterns has the potential to increase machinery utilization and lower per acre machinery and equipment costs as well.

2. **Span of Control** - A key concern in crop operations is the perceived and in many cases real limit on size of operation because of the difficulty of monitoring progress and performance on large geographically dispersed acreages. The fundamental argument is that if plant growth processes can only be monitored by people with unique skills and those resources are costly or expensive to train, the monitoring process limits the span of control to what one individual (or at least a few) can oversee personally. If electronic monitoring systems can be developed that monitoring the processes of plant growth (whether it be machinery operations or the growth process of the crop or the level of infestation of insects or weeds), fewer human resources are needed for this task and generally larger scale is possible. An analogy is the transformation from the labor intensive corn processing or feed milling plants of the past to the electronically controlled and monitored plants and mills of today with computer based monitoring and control systems and few employees producing significantly more output. Crop production can and will move more and more in that direction with improved electronic monitoring and control systems which expands the span of control.

3. **Differentiated Products** - Part of production agriculture is expected to move from commodity to differentiated product production. One dimension of that differentiation may be the production process itself -- for example the use of chemicals during only certain stages of the plant growth process. And with more specificity required in the raw material to meet qualified supplier requirements, increased measurement and monitoring of both the growth process and the end product will be important for quality control and compliance. In fact, precision farming in its broader context of measuring, monitoring and controlling the plant growth process is expected to have more payoff in differentiated production rather than commodity product production because it has the potential to not only lower cost but to simultaneously enhance revenue by producing a higher valued product.

4. **Food Safety** - One of the most difficult risks for a food processing firm to manage is the potential of contamination in raw materials. And for a branded product food company, a food safety scare can be disastrous. The improved measurement and monitoring of the soil preparation, growth, harvesting, storage and handling and processing processes that have the potential to be part of precision farming in the future will enable trace-back from end-user through the production/distribution chain which is the only secure method of guaranteeing food safety. If food safety concerns continue to increase and consumers demand more documentation that food products are in fact safe, precision farming has the potential to become one of the most effective ways of providing that documentation and reducing the risk of food contamination.

5. **Environmental Benefits** - Much has been asserted about the benefits of site specific farming in terms of more accurate and precise application of chemicals and fertilizer to better match plant needs and thus reduce leaching and runoff into ground and surface water. Undoubtedly this potential exists, but caution should be exercised in these assertions. Without improved measurement and monitoring of chemical and fertilizer uptake by the plant and movement in the soil, we are not sure of the environmental impact. What if the precision farming recommendations are for the highest application of chemicals or fertilizer on the soils closest to a stream or with a shallow water table and heavy rains occur after application? No doubt site specific farming and precision agriculture have the potential to reduce environmental degradation, but we need to measure and monitor this phenomena to be sure we are obtaining the expected results.