1997

Economics of Precision Farming: Payoff in the Future

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Soil Science News & Views

Vol. 18, No. 5, 1997

ECONOMICS OF PRECISION FARMING: PAYOFF IN THE FUTURE

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Introduction

Precision agriculture is an infant technology. This infant has some of the signs of eventual greatness, but its full capacities will not be evident for some years. Like all infants, it will require an investment of time and resources to help it to maturity. This investment will have some short term payoff, but the main benefits will be in the future.

The purpose of this presentation is to help you manage your adoption of precision farming technology for that future payoff. The specific objectives will be to: review what we have learned about the economics of precision farming, identify future benefits, and outline an adoption strategy designed for long term competitive advantage.

What We Have Learned

Economics change as technology changes. Almost every week new equipment and software are put on the market that improves our ability to collect and use site specific data. Our understanding of the economics of these new tools is far from perfect, but gradually we are beginning to understand the trends and the general characteristics.

Costs - Studies of site specific management have often focused on changes in crop input costs, such as fertilizer or herbicide, while sometimes ignoring investment costs (Table 1). In particular, the cost of developing "human capital" is often omitted. We are not born with the capacity to use site specific management profitably. It must be developed. Costs might include: workshop and short course fees, time away from other work and "wrong decisions" made while learning.

The annual cost of using site specific tools depends heavily on the useful life of that equipment, software, databases, and skill. If site specific management tools are obsolete in 3 or 4 years, like other computer based technologies, the annual cost of use can be surprisingly high.

Benefits - The benefits of site specific management have proven difficult to measure. Crop yield changes in side-by-side comparisons of site specific and whole field technologies might be due to inherent soil differences or microclimate. Simulation of what the field might have produced under another management system is time consuming and often inaccurate. The environmental benefits of site specific management have been discussed, but they have not been measured.

Short Term Profitability - Currently available site specific management technologies are profitable in some cases, but studies suggest that they often fail to cover all additional costs in the production of bulk commodities like corn, soybeans, and wheat (Table 1). The profitability of precision management is greater in higher value crops, such as vegetables, potatoes, and seed. Low profitability in bulk commodities may be due as much to management problems as to technology.

The importance of having a site specific management system emerges clearly from available studies. It is unlikely that one or two inputs will consistently pay the costs of site specific data collection and use.

Future Benefits

Long run profitability of previous farming technology depends on the development of management systems that link inputs applied with yields harvested on specific sites. These management systems will be some combination of computerized decision support systems and the accumulated wisdom of experienced managers. Decision support systems require databases. Wisdom comes with long experience. These management systems will be site specific. Generic decision support systems will be developed, but their performance on your farm will be enhanced by data from your farm.

Agricultural databases take time to accumulate. For example, because of weather variability, accurate information on site specific yield potential and problems may require several seasons of data. Retesting soils at the same sites creates data on fertility trends.

History shows that most of the benefits of any new agricultural technology go to the early adaptor. Those who lag have often been forced out of farming. Precision farming is expected to follow the same pattern. Those who begin to accumulate data and experience now will be ready to use improved precision technology as it matures.

Data Management - Who benefits from precision farming will be determined by how management of precision data is organized. To realize the full benefit from precision farming, farmers will probably need to pool data. You can not try every alternative on your farm, but by pooling data with other farmers who have different management approaches, it will be possible to identify the best combination of seed, fertility, tillage, and pest control.

Four alternative organizational forms have been proposed for data pooling:
1) agricultural input manufacturers and suppliers,
2) independent data management companies,
3) non-profit data management groups, and
4) land grant universities.

Each alternative has its advantages and disadvantages. Data management by ag input manufacturers raises questions of credibility and representativeness. Some suspect that manufacturers would manipulate the data to enhance sales. Data collected exclusively from the clients of a manufacturer might not be representative of farmers as a whole; and as a consequence, the fine tuned crop plans developed might not be useful outside the client group.

Strategic Management - For precision farming, eventual developments can be grouped in three scenarios:

a) Information Agriculture - This is the rosy scenario in which farmers share data and results, and as a consequence costs are cut, yields improved, and the environment is maintained. Farmers, industry, and universities are partners in developing these better crop "recipes."

b) Industrial Crop Production - Precision data and analysis are controlled by large companies. They develop proprietary crop recipes. Some farmers become minimum wage tractor drivers and others become "integrators." Only part of precision farming potential is developed.

c) Technological Deadend - Practical and profitable uses are not developed for precision farming, perhaps because data is not shared.

Adoption Strategy

In this environment of rapid technological change, farm and agribusiness adoption strategy should be based on finding the least cost way to build site specific management capacity and databases. Agriculture is becoming a knowledge based industry where what you and your employees know is a key factor in profitability. Ownership of precision farming tools has a place in this strategy, but it is not the only option.

For some farmers, the least cost learning strategy will be using custom services to build databases and gain experience with the spatial variability of their fields. With custom services, data ownership will be an issue. Farmers who plan to use custom services to help build their precision farming database should have a written contract that specifies their rights to the data, and they should take care that the data is available in a format that can be transferred to other software.

For many grain farmers, a yield monitor will be the point of entry to ownership of precision farming tools. Yields are an essential layer in a spatial database for your land. Interpreting and using yield maps is the key step in developing precision management skills. Mapping packages sometimes store data in proprietary formats that can not be used by the next generation of software. To facilitate use of previously collected yields by new software, raw yield data should be retained.

Soils data is another essential layer in your precision farming database. Soil sensors may eventually make grid sampling obsolete, but in the meantime grid sampling is the best way to collect soil data. If purchased services are used to collect soils data, care should be taken to establish ownership of the data and to conserve the raw data.

Conclusions

Some aspects of precision farming will become standard practice for North American agriculture, but we do not yet know which aspects will prove most practical and profitable. The most durable investment that farmers and agribusiness can make in this area is the development of management skill and databases. Hardware and software are sure to change, but site specific data bases and the capacity to use precision management tools profitably will provide a long run competitive advantage.

Kenneth L. Wells

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Table 1. Profitability Conclusions from 11 Precision Farming Studies

Study	Crop	Inputs Managed	Treatment of Sampling & VRT Cost ($)	Precision Farming Profitability
Observed Yields				
Carr et al. 1991.	Wheat, barley	N,P,K	Not included	Mixed
Fiez et al. 1994.	Wheat	N	Not included	Yes, potentially
Hammond. 1993.	Potato	P,K	Variable & fixed	Inconclusive (costs only)
Lowenberg-DeBoer et al. 1994.	Corn	P,K	Variable & fixed custom rates	No, but might for low-soil test fields
Wibawa et al. 1994.	Wheat	N,P	Variable & fixed w/ 1 yr. amort.	No (but over-ests. annual fixed costs)
Wollenhaupt & Buchholz. 1992.	Corn	P,K	Variable & fixed w/ 4-yr amort.	Mixed; deps. on yield gain
Wollenhaupt & Wokowski. 1994.	Corn	P,K	Variable & fixed w/ 4-yr abort	Mixed; deps. on sampling density & abort. period
Simulated Yields				
Beuerlein & Schmidt. 1993.	Corn, soy	P,K	Variable & sample; no equip.	No, but more efficient fertilizer use
Hayes et al. 1994.	Corn	N	Not included	Higher revenue has potential to cover costs
Hertz & Hibbard. 1993.	Corn	P,K	Variable & fixed custom rates	No, but close to uniform in profitability
Maharnan. 1993.	Corn	P,K	Variable & fixed custom rates	No if 1-yr sample abort.; yes if 4-year sample abort.

SOURCE: J. Lowenberg-DeBoer and S.M. Swinton, "Economics of site Specific Management in Agronomic Crops," Staff Paper 95-14, Department of Agricultural Economics, Purdue University, West Lafayette, IN. 1995.

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