PURDUE AGRICULTURAL ECONOMICS REPORT

MAY 2001

What Is the Economic Impact from Foot and Mouth Disease and What Should We Do About It?

Otto Doering, Professor; Ken Foster, Professor; Chris Hurt, Professor; and James Pritchett, Associate Professor

We face a serious challenge in the prevention and control of Foot and Mouth Disease (FMD). FMD could be devastating to our livestock and dairy producers in two ways. First, the disease reduces the productivity of livestock and dairy as well as requiring the destruction of infected and exposed animals to control it. Second, the public confuses FMD with mad cow disease which can be dangerous to humans where FMD is not. This then reduces consumer demand for meat and dairy products. In addition, there are large indirect impacts that are negative.

Today's tremendous flow of people and goods across borders greatly increases the odds of an outbreak of FMD in the U.S. Given this, and the potentially devastating impact, the best procedure is not only to increase our border defenses against Foot and Mouth Disease, but also to plan and organize in advance to combat it effectively when it arrives. This is not a short term concern. We will need to continue to be vigilant and prepared in the future.

No one can come up with a specific dollar cost for a Foot and Mouth Disease outbreak. One study done some years ago has a range of $2 billion to $24 billion depending upon the extent of the outbreak, the control strategy used, and the success of the strategy. However, this wide range of costs illustrates that there is great benefit in planning ahead to minimize the costs. Some of the key things that determine the economic consequences are:

- *Geography* - Where and over what area will the outbreak occur?
- *Timing* - How quickly will outbreaks be detected and dealt with? This will determine the extent of the outbreak. For example, discovery at the packing plant probably means it is already widespread.
- *Strategy* - What strategy will be used to respond to the outbreak? Eradication through quarantine, limited vaccination, complete vaccination, or letting the disease run its course all have their own consequences.

There is a wide range of different possible costs that might result from an outbreak of FMD. These will depend upon the geography, the time element, and the degree of success of whatever strategy is adopted. Some of these are:

- *Loss of meat export markets.* The proportion of our meat production that we export is not as great as that of Denmark or Australia, but it has grown in recent years and is important to our producers. We export 7% of our pork products and 10% of our beef products. Prohibitions would be placed on the sale and international shipment of animals and animal products. Australia, New Zealand, and Canada might capture some of our markets, especially the lucrative Japanese market. This depends upon how the international rules governing disease outbreaks are applied. For example, will quarantines be allowed on a regional basis or enforced nationally? This is a critical issue in terms of our ability to export. Meat from animals with FMD can be sold as cooked meat, and we might shift

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this to trade in lower value markets, like Russia.

- *Reduced domestic meat (and dairy) demand*. The amount of any domestic cutback in consumption is a critical unknown. There is little danger to human health from FMD. However, the key is how consumers will react to the consumption of infected species and how long any reluctance to consume such meat and dairy products persists. Will we face a general loss of confidence in the safety and quality of meat and dairy products? Loss of confidence in animal products due to Mad Cow Disease (BSE) has been substantial in Europe. American consumers confuse Mad Cow with Foot and Mouth even though BSE has never been found in the Americas.

- *Reduced domestic meat (and dairy) output*. Initially, healthy quarantined animals might be slaughtered. The number of quarantined animals that had to be destroyed would likely be small compared with market liquidation occurring from lost exports and reduced domestic consumption. This might initially increase domestic supplies and drive prices downward. Later there might be a decline in production if the outbreak were extensive as herds declined and additional animals are destroyed. For dairy products there would be a decline in output from the start.

- *Reduction in demand for animal feed* (like corn and soybean meal). The decline in animal numbers would result in fewer animals to feed, and feed grain prices would drop. In March, the fact that hogs from North Carolina were being tested for FMD drove down the prices of both corn and soybeans on the day of the announcement. However, it is the long-term price impact that is most critical.

- *Eradication costs*. These could be very high. Recently, the Federal Emergency Management Agency conducted a tabletop exercise of a worst case outbreak in Iowa and found it would have required 50,000 people to contain it. Our unexposed animal population has no antibodies. Animals exposed to the disease are usually destroyed to prevent the spread of the disease. Vaccines may produce only temporary protection so revaccination would be needed at intervals. Vaccinated animals must be slaughtered before international trade can be resumed because they are positive carriers of the disease. Should the disease become widespread or affect large herds, the loss would not only be in this generation of animals but also in the breeding stock for future animals. Individual producers would have to rebuild herds, obtaining disease free animals from somewhere. Because our industry tends to be more concentrated than those in most other countries, this would represent large individual recapitalizations.

- *Indirect costs*. In Britain, the most important indirect cost, larger than the direct cost, is the loss of tourist revenue in the affected areas. There are a wide variety of other potential indirect costs. There are costs to the transportation industry to maintain the quarantine and to disinfect goods and transportation equipment. There are costs to the food processing and marketing industry from consumer concerns and in handling and segregating FMD products. The magnitude of these will depend on the character and extent of the FMD outbreak.

- *Other factors*. Public opinion is very important. From the economic standpoint this affects such things as demand for meat and dairy products under FMD conditions. Public willingness to live with and cooperate with quarantine rules is critical. We will have to face the public reaction to massive destruction of domestic animals. Broad public support and compliance are essential for the success of whatever FMD control strategy is used.

There are many different drivers of costs for different FMD scenarios. The complex interaction among the nature of the outbreak, control strategies, consumer responses, market reactions, trade reactions, and the fact that one group's costs may actually yield benefits to another group makes the range of potential costs so great.

As an example, take the case of a large concentrated hog operation that is infected and quarantined. The herd would be destroyed, and, even with compensation, the owner would have to invest in rebuilding the herd and getting it certified FMD free. This outbreak might induce consumer concern about the safety of the nation's pork supply and drive down demand and prices for pork nationally. This would hurt all pork producers (maybe extending into beef as well). It would benefit those consumers who continued to eat pork at lower prices. (This particular indirect impact would be a positive economic impact of this event.)

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For trade in pork products, if international rules allowed just the infected region to be quarantined, producers in other regions could continue to export, but producers in the quarantined region would be shut out of trade. Within the region, if the outbreak were well isolated, other producers would not necessarily have their herds destroyed, but this would depend upon the quarantine boundaries. Producers within the infected quarantine area would suffer equally with the first infected producer. Their labor force would be unemployed. Packing plants depend on constant flows of animals, and significant loss of live animal supply would be costly. Packing plants taking animals from the region would also assume a testing burden and there would be extra transportation costs.

What will be most important is the choice of the best strategy to deal with the outbreak. The critical link in the chain of any strategy is the initial rapid identification of the disease. There are other diseases that look similar, so producers must be willing to notify a veterinarian at once and not wait when faced with a suspicious case. Today, the disease can only be confirmed at Plum Island, New York and Animal Disease Centers at Ames, Iowa. We should allow other qualified animal disease diagnostic labs to perform the test as well. It will reduce the time lag before positive identification, and producers may be more willing to come forward if dealing with local people they know and trust. Second, we must be able to quickly mobilize the resources capable of doing the job expertly. Finally, we need to make it clear, and official, to producers that adequate compensation will be paid that recognizes the full value of their animals, be they breeding stock, dairy cows, or meat producing animals. Only if producers have confidence in the effectiveness and equity of an eradication effort will they participate wholeheartedly.

69th Annual Indiana Farm Management Tour

Wells, Huntington, and Whitley Counties
Thursday, Friday, July 5-6, 2001

Five outstanding farm families are hosting the 2001 tour. They include:

- Chris/Kristyn Geiger, near Markle, Thursday, 1 pm
- Dennis Farm, NE of Huntington, Thursday, 3 pm
- Steve/Beth Sickafoose, south of South Whitley, Friday, 8 am
- Ray Cormany & Sons, NW of Columbia City, Friday, 10 am
- Dave and Ron Johnson, SW of Churubusco, Friday, 1:30 pm

In addition, at 7:30 pm Thursday, Commodity Price Outlook and Farm Policy Alternatives will be presented at Hiers Park (The Fairgrounds) in SE Huntington. Purdue Ag Economists Chris Hurt and Wally Tyner will lead the discussion.

Also, Friday lunch at Northeast Purdue Ag Center will be provided by local businesses to the first 350 persons who pick up free tickets at the extension offices in these counties or at earlier stops on the tour. For more information, call Howard Doster at (765)494-4250 or visit the website at www.agecon.purdue.edu/extensio/farm_mgmt_tour/index/htm.

34th Annual Purdue Top Farmer Crop Workshop

July 22-25, 2001

Last year a record attendance participated! Workshop coordinator, Howard Doster, says this year's program is better. Call him at (765)494-4250 to receive an invitation or use e-mail at www.agecon.purdue.edu/extensio/Top_Farmer/index.htm to find the program brochure and registration form.

Speakers include seventeen farmers; twelve industry representatives, including several company presidents; and twenty-two professors from three universities.

Topics are focused toward helping participants improve your management performances.

Ken Ferrie, *Farm Journal* crop specialist and Francis Childs, Iowa farmer and 2000 National Champion Corn Grower, head up the crop technology speakers.

Gary Maas, President of AGRIcareers, will administer a management behavior style test.

Marketing advisors, Dennis Alkire and Bob Utterback plus Purdue's Chris Hurt will share the marketing advice section.

Several farmers will share how they are farming together, including two who are just starting, and one who is about to sell out to his employee.

Several speakers will address how farmers might add value to their specialty crop production.

Finally, farm policy issues will be the feature attraction. In addition to analyses by Purdue staff, invited speakers include three farmers: Jim Moseley, former Assistant Secretary of Agriculture; and Read Smith, President of the National Association of Conservation Districts; and Craig Blindert, author of the Flex/Fallow policy proposal.

Local Cooperative Restructuring

Jennifer Vandeburg, Research Associate; Joan Fulton, Associate Professor; Susan Hine, Assistant Professor, Department of Agricultural and Resource Economics, Colorado State University; and Kevin McNamara, Professor

Consolidation in all areas of agribusiness is creating an increasingly challenging business environment for local cooperatives. "Fewer" and "bigger" are key words in describing why a cooperative's customers, suppliers, and competitors all possess greater market power than in past years. This article is the second in a series reporting results of recent and ongoing research at Purdue University's Department of Agricultural Economics examining how local cooperatives are responding to these challenges. In particular, local cooperatives are engaging in a variety of business arrangements— mergers, acquisitions, joint ventures, and strategic alliances— in order to remain competitive.

Data for this study were collected through in-person interviews with managers of 35 locally owned Indiana farm supply and grain marketing cooperatives in May and June of last year. These managers were asked about the restructuring activities in which their cooperatives had engaged during recent years, the factors that motivated the restructuring, and what contributed to the success of these arrangements.

In the following sections we report on the extent and types of restructuring by local cooperatives in Indiana. Then, we describe the driving forces behind these arrangements as well as the factors that contribute to success.

Use of New Business Strategies/Business Structures

The most common business arrangements identified by study participants are joint ventures and strategic alliances, as shown in Table 1. A joint venture is formed when two firms choose to contribute assets or other resources to a jointly owned project, often involving the establishment of a new business entity, such as a limited liability corporation (LLC). A strategic alliance is a much less formal agreement between two firms, such as a preferred supplier agreement. Eighty percent of the managers mentioned involvement in one of these relationships.

Acquisition of other cooperative and non-cooperative businesses, generally smaller, competing firms, is a strategy often used by local cooperatives to increase market share. Two-thirds of the cooperatives have acquired at least one other firm in the last five years.

Starting in the early 1900s, local cooperatives were established across the state, many between 1925 and 1930, as part of the Indiana Farm Bureau Cooperative system. At one point, there was a local cooperative in every county in Indiana (Boring). As the agribusiness sector restructured through time, waves of mergers— the joining of two or more firms into a single business entity—between and among local cooperatives swept the state. The last five years have been no exception. In the spring of 2000 there were 38 local farm supply and grain marketing cooperatives in Indiana, 35 of which participated in the survey. Fourteen of the 35 cooperatives surveyed were either currently involved in a merger or had been involved in a merger in the last five years. In one case, both partners in an ongoing merger negotiation were interviewed.

Mergers are often used as a tool for cooperative growth. Some managers indicate they perceived that cooperatives needed to increase in size to remain competitive. A minimum size is required for firm efficiency, because many cooperative operations benefit from economies of scale. Managers also suggested that greater firm size allows the cooperatives to offer their members a broader range of products and services, and in this way remain competitive.

Joint Ventures and Strategic Alliances

Managers described a variety of business activities as the focus for a joint venture, in response to an open-ended question. As a result of their responses, categories for types of joint ventures and strategic alliances became evident. The total number of all joint ventures and strategic alliances for each type is shown in Figure 1. If a manager described two projects that fall into the same category, then both are included in the totals in Figure 1.

Just over half of the cooperatives reported sharing an employee (or team of employees) who served as a risk coordinator. The risk coordinator monitors and ensures environmental and workplace regulation compliance. For most Indiana

Table 1. Number of Cooperatives Involved in New Business Structures over the Last Five Years

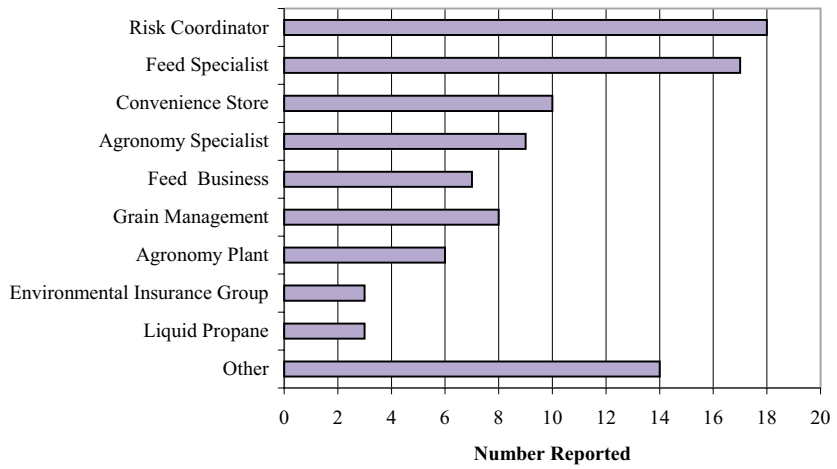
	Joint Ventures/ Strategic Alliances	Acquisitions	Mergers
Number Involved	28	23	14
Percent Involved	80%	66%	40%

cooperatives, risk coordination is not a fulltime job and has economies of scale, so a shared business arrangement has proven effective.

Seventeen managers throughout the state also reported sharing a feed specialist. Sharing a feed specialist allows cooperatives to hire an individual with greater expertise, in this case, in livestock nutrition, than it would be able to afford on its own. Other joint ventures included ten cooperatives sharing in convenience store investments and management projects, nine cooperatives sharing agronomy specialists, and seven cooperatives pooling assets for a more efficient feed manufacturing and distribution business. Eight cooperatives partnered with non-cooperative firms for management of cooperative-owned grain facilities. The grain firm partner brings merchandising and facility management expertise to the project. Cooperatives have also shared the investment and staffing for agronomy plants with neighboring cooperatives, have formed an environmental insurance group and are forming liquid propane marketing and distribution ventures with local rural electrification cooperatives. There were also a variety of other ventures and alliances, such as preferred supplier or distributor agreements, shared administrative employees, and non-traditional business projects, such as lawn and turf businesses.

Managers were asked to rate the level of success for each venture on a five-point scale, with 1 being least successful and 5 most successful. These ratings were then averaged for each type of venture or alliance activity. The environmental insurance group has an average success rating of 5.0, indicating that all the managers reporting involvement in the group gave this alliance the highest possible success rating (Figure 2). The projects with the next highest success ratings, the shared risk coordinator, rated 4.4, the shared agronomy specialist, at 4.1, and the shared feed specialist, at 3.8, were those that involved shared personnel. In the case of the grain management ventures, rated 3.7, the goal of the agreement was to bring in greater expertise to more fully utilize existing capital investment. Projects that required new capital investment by the cooperative—C-stores, feed businesses, and agronomy plants—were rated as less successful, at 3.0, 3.0, and 2.8, respectively.

Figure 1. Types of Joint Ventures and Strategic Alliances Reported



Acquisitions

Local cooperatives often used acquisitions to increase market share through the purchase of a local competitor. In response to an open-ended question, managers described the types of acquisitions. As a result, categories for types of acquisition became evident. The total number of all acquisition events for each type of acquisition is shown in Figure 3.

The most common acquisition reported was the purchase of a petroleum fuel distribution business. A large number of Terra dealerships became available for acquisition in 1998, 1999, and 2000, when Terra, Inc. first sold off plants as it experienced financial difficulties, and then Cenex/Land O'Lakes made plants available after buying out Terra. Therefore, it was not surprising that cooperatives in Indiana bought 17 Terra plants in the last five years. Fifteen independent agronomy plants were also acquired, usually being the purchase of a facility from a locally owned competitor who had decided to exit the business. Three liquid propane distribution firms were also purchased.

Figure 2. Joint Venture/Strategic Alliance Average Success Ratings

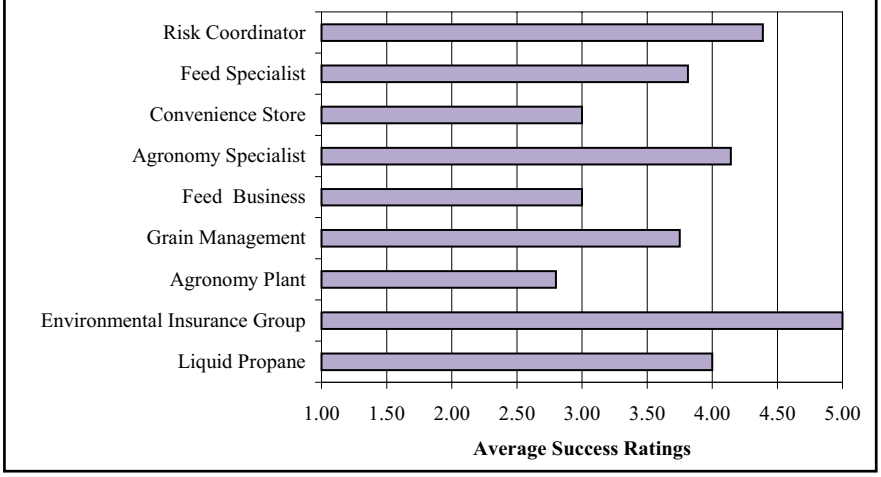


Figure 3. Types of Acquisitions Reported

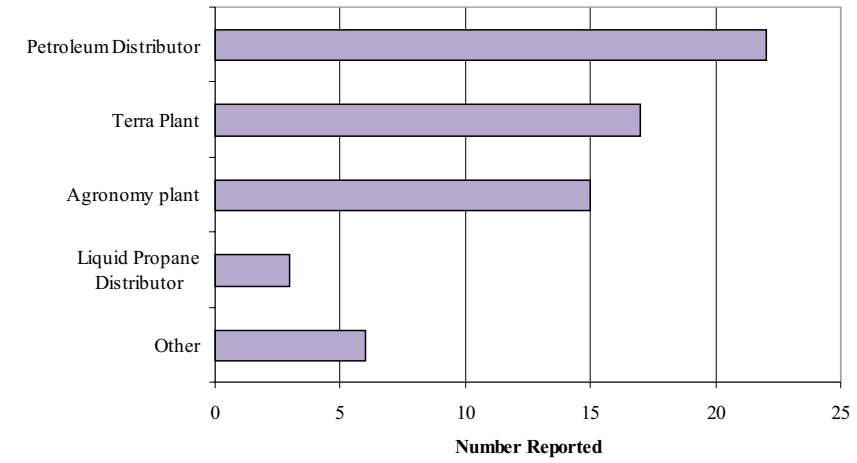


Figure 4. Acquisition Success Ratings

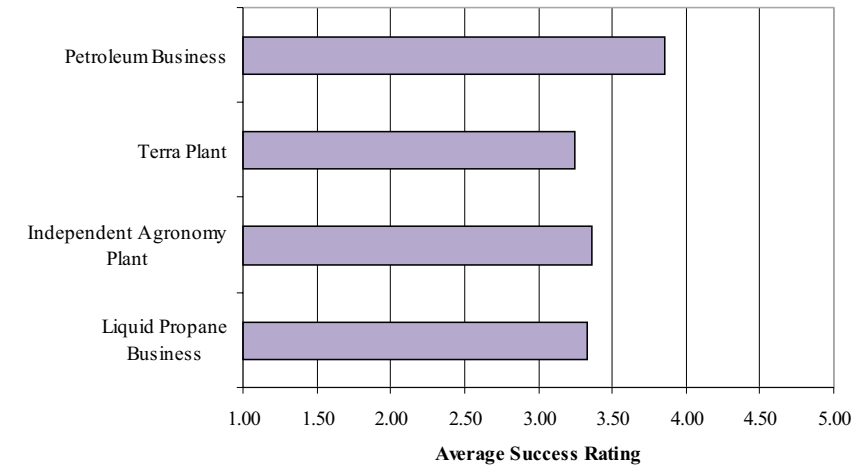
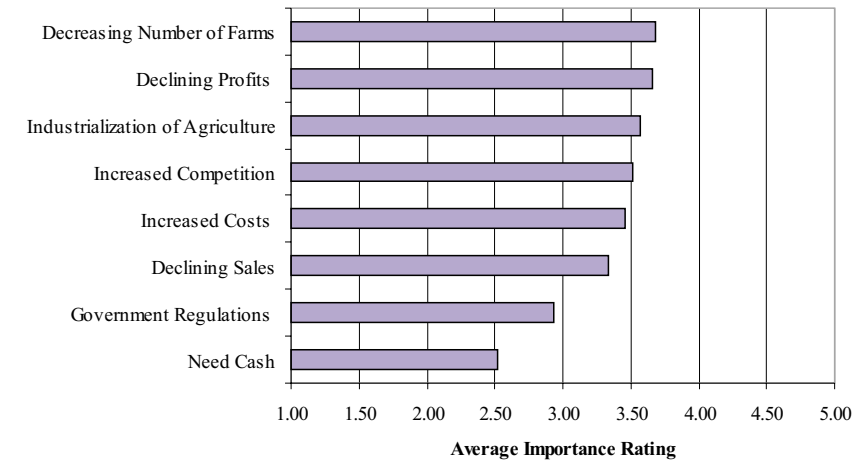


Figure 5. Importance of Driving Forces for Joint Ventures and Strategic Alliances (average ratings)



Cooperative managers rated the success of each acquisition, and the average rating for each type is reported in Figure 4. Acquisitions tended to receive lower average ratings than joint ventures and strategic alliances, with a range of 3.3 to 3.9, possibly due to the difference in objectives between the two types of arrangements. While joint ventures tended to be designed to expand a cooperative's influence in a new market or business, acquisitions generally expanded market share in existing products and services. Opportunities for acquisition often occurred when a local business owner decided to retire or close the business, leaving the cooperative with a choice—buy the business or take the chance that someone else would buy it and continue to compete with the cooperative. Petroleum distribution business acquisitions received an average success rating of 3.9, on a five-point scale. Independent agronomy plant acquisitions were given an average success rating of 3.6, while liquid propane distribution businesses rated 3.3.

Many of the Terra plant acquisitions had occurred too recently for a success rating to be given, but the average rating for the four Terra plants purchased earlier was 3.3. This lower rating may be due, in part, to the financial difficulties that prompted Terra to sell their facilities in the first place. These plants may have already been experiencing challenges in the marketplace that affected their smooth transition to being a successful investment for the cooperative.

Mergers

While over half of the managers interviewed indicated that the merger had been completed too recently for a fair assessment of success to be made, managers generally held positive opinions about how the merger was progressing.

Motivation for Cooperative Restructuring

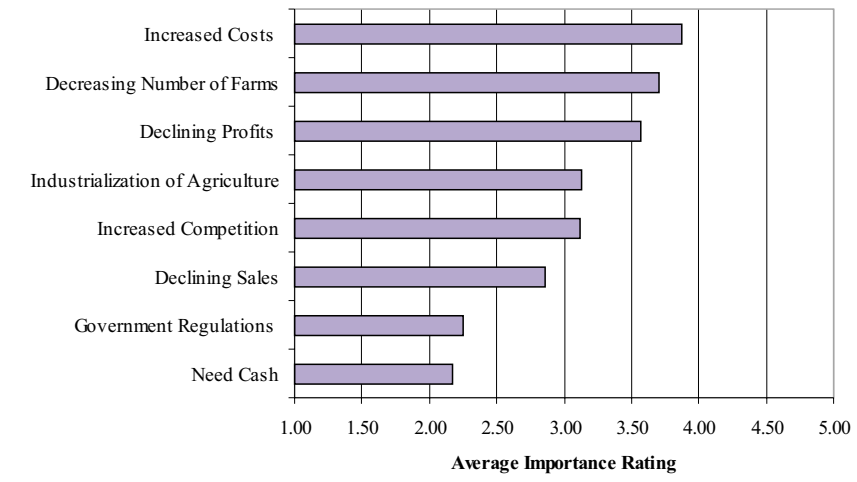
To identify motivating factors for restructuring, managers were asked to rate the importance of several factors, or driving forces, behind joint

ventures and strategic alliances, on a scale of 1 (least important) to 5 (most important). The average (or mean) importance ratings for each of the driving forces for joint ventures and strategic alliances are reported in Figure 5. The driving forces specifically associated with consolidation in agribusiness—decreasing number of farms, declining profits, the industrialization of agriculture, and increased competition—received average importance ratings above 3.5. Increased cost and declining sales, factors that also tend to result from consolidation, scored above 3.0. The impact of government regulation and the need for cash were not viewed as nearly as important.

Managers also were asked to rate the importance of factors motivating mergers and acquisitions (Figure 6). While issues closely associated with agribusiness consolidation were again rated the highest, the relative importance of some factors differed. Most notably, increased costs, previously with the fifth highest rating for motivating joint ventures and strategic alliances, now had the highest average importance rating at 3.9.

Mergers address these driving forces through increased firm efficiency, because overhead was distributed over more sales. A larger, merged cooperative can justify investment in equipment and personnel needed to meet the greater technical needs of modern agricultural customers/members. The most common types of acquisitions addressed the issue of increased costs, since the businesses purchased were those that offer economies of scale, as with the petroleum distribution businesses.

Figure 6. Relative Importance of Driving Forces for Mergers and Acquisitions (average ratings)

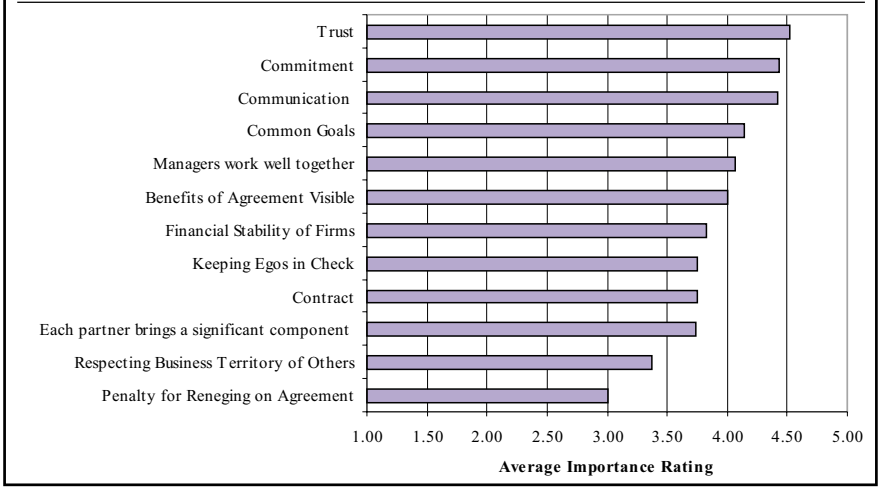


Factors Contributing to Successful Restructuring

To identify key success factors for restructuring arrangements, managers were asked to rate the importance of factors that might contribute to the success or failure of a joint venture or strategic alliance (Figure 7). All of the success factors received importance ratings of 3.0 or higher, again on a five point scale with 1 being least important and 5 most important. Intangible factors related to interpersonal dynamics received the highest ratings—trust had a score of 4.5, commitment to the project, 4.4, and communication, 4.4. Teamwork-oriented factors, having common goals for the project, managers that worked well together, and being clear about each firm's benefits from the project, were rated 4.1, 4.1, and 4.0, respectively. Tangible factors, like the financial stability of the firms, with a rating of 3.9, having a written contract, at 3.8, and a penalty for reneging on an agreement, at 3.0, were rated lower in importance. These importance ratings suggest that interpersonal communication skills are vital to the success of a restructuring arrangement.

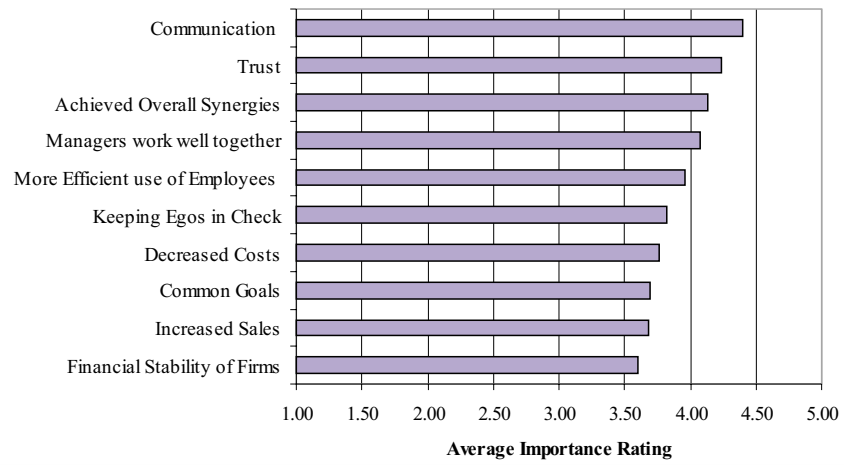
The success of mergers and acquisitions may be even more critical to the performance of the cooperative, because these restructuring arrangements are more permanent than joint ventures and strategic alliances. All of the success factors for mergers and acquisition were rated as important, with the average ratings ranging from 3.6 to 4.4. Managers again placed interpersonal dynamics factors—communication, rated 4.4, trust, at 4.2, and managers that work well together, at 4.1—as important for contributing to success (Figure 8). More tangible

Figure 7. Importance of Success Factors for Joint Ventures and Strategic Alliances (average ratings)



factors, like decreased costs, rated 3.8, more efficient use of employees, at 4.0, and increased sales, at 3.7, also received strong, but lower, average ratings. Smooth transition, as the cooperatives meld into a new firm, or the acquisition becomes part of the cooperative, needs an environment that fosters trust and clear communication.

Figure 8. Relative Importance of Success Factors for Mergers and Acquisitions (average ratings)



Conclusion

Cooperatives struggle to remain competitive as consolidation in agribusiness continues. Many cooperatives are engaging in joint ventures, strategic alliances, mergers, and acquisitions as strategic actions. Joint ventures allow cooperatives to acquire resources and offer services that would otherwise be financially prohibitive. Cooperatives are using acquisitions to increase market share within their market territories by reducing the number of local competitors and achieving economies of scale. Mergers are allowing cooperatives to quickly grow to a size that improves firm efficiency and makes a more competitive product and service offering feasible.

All new business arrangements involving restructuring should be evaluated in a business context and be pursued only if deemed economically profitable, financially feasible, and a good strategic business decision. The results presented here indicate that the interpersonal dynamics of trust, communication, commitment, and having managers that work well together are also critical to the success of restructuring. This suggests that training for cooperative managers, employees, and board members needs to include communication skills, and trust building and team building exercises.

Reference:

Boring, Gary, President and CEO, Countrymark Co-op, Inc. Personal Communication. April 16, 2001.

New Faculty

Assistant professor Christine Wilson is the newest faculty member to join the Center for Food and Agricultural Business and the Department of Agricultural Economics at Purdue University. Wilson will serve as an instructor in programs sponsored by the Center, in addition to undergraduate courses in marketing management, accounting and agricultural finance.

Christine Wilson

"Christine's background and research interests will add even more depth to our programming," says Jay Akridge, director of the Center for Food and Agricultural Business and professor of agricultural economics. "She has already demonstrated her effectiveness in the executive classroom during a session she co-instructed at our ASTA (American Seed Trade Association) Management Academy – the response was very positive. We are extremely pleased to have her join our faculty."

Wilson's research primarily focuses on four areas: agribusiness management, finance, marketing, and demand and price analysis. She has specific interest in the analysis of investments, strategies, pricing and efficiencies.

Wilson also has experience as a grain and oilseed market analyst for Koch Industries in Wichita, Kan. She provided research analyses and trade recommendations to internal grain and oilseed businesses. Wilson was also responsible for providing educational assistance concerning econometric and statistical methodologies.

Kansas State University has awarded Wilson all of her degrees, including a bachelor of science in agribusiness, a master's in agricultural economics, and a Ph.D. in agricultural economics with specializations in agribusiness management, agricultural finance and marketing.

Wilson, a native of rural southwestern Kansas, has earned several awards and honors for her work. She is a member of several professional organizations, including the American Agricultural Economics Association and the International Food and Agribusiness Management Association.

Precision Agriculture Profitability: Implications for Land Values and Leasing

J. Lowenberg-DeBoer, Director, Site-Specific Management Center

Precision agriculture has proven its value for only a few uses. Yield monitors are used on roughly 20% of Corn Belt grain acres. Lightbars are used for guidance on sprayers and spreaders by about 30% of custom applicators in the Midwest and also by many producers. Variable rate application of lime has become common in the eastern Corn Belt. But many other aspects of the precision farming vision have not yet been realized or become common practice.

Precision farming technology has improved dramatically in the last 10 years, becoming easier to use, more reliable, and less expensive. But many questions remain about the profitability of the technology. This article summarizes the economic studies of precision agricultural technology, identifies key innovations needed to improve profitability, and outlines the implications for landowners.

Sometimes "precision agriculture" and "site-specific management" are used interchangeably, but there is an important distinction. Site-specific management is an idea as old as agriculture. Essentially it means doing the right thing, at the right time, in the right place. In the 20th century, agriculture became less site-specific. The economic pressure was to treat large areas with uniform crop recipes.

Precision farming is essentially information technology applied to agriculture. It uses global positioning systems (GPS), geographic information systems (GIS), sensors, and other electronics to help make site-specific crop management possible on a commercial scale.

Summary of Economic Studies

In their review of economic studies of precision agriculture, Lambert and Lowenberg-DeBoer (2000) found 108 articles that reported economic analyses. Of those 108 articles, 63% reported profits. Unfortunately, there was no standardization in the methods used, and some analyses omitted major costs or overestimated benefits. The costs of data gathering and data analysis were sometimes left out. Very few studies included the cost of developing the skill to use precision farming tools.

In an effort to overcome the lack of standardized methods, Swinton and Lowenberg-DeBoer (1998) reworked the budgets on nine studies of variable rate fertilizer (Table 1). Variable rate fertilizer is only one of many potential uses of precision agriculture technology, but it has been the subject of numerous economic studies because it was the first precision farming technology introduced commercially. The far right column of Table 1 gives the percentage of "site-years" that the technology was profitable. For example, if a study had results from six farms over three years, that would make a total of 18 site-years. If the technology was profitable on nine of those farms over the three-year period, the percentage of "site-years profitable" would be 50%.

The main conclusions drawn from Table 1 are that: 1) variable rate fertilizer seems profitable for higher value crops, like sugar beets; 2) variable rate fertilizer is unprofitable for extensive dryland crops like wheat; and 3) for corn and soybeans profitability depends on where the trial was conducted and how the technology was implemented (e.g., grid vs. soil type, interpolated maps vs. management zones).

Key problems with the studies reported in Table 1 include the focus on "stand alone" technologies that manage only one or two inputs and the use of whole field fertilizer recommendations to create site-specific fertilizer application plans. It is argued that an integrated precision farming system which manages many inputs will be more profitable

Table 1. Profitability of Variable Rate Fertilizer in Nine U.S. studies

Crop	Inputs	Grid Acres	Site-years Profitable
Higher Value Crops:			
Sugar Beets	N	2.75	100%
Extension Dryland Crops:			
Wheat, Barley	N, P, K	Soil Type	20%
Wheat	N	3.0	0
Wheat, Barley	N, P	Soil Type	0
Corn and Soybeans:			
Corn	P,K	3.0	42%
Corn	P,K	Soil Type	50%
Corn, Soybeans	P,K	2.5	83%
Irrigated Corn	N	0.75	50%
Corn	P,K	2.5	0%
Corn, interpolated	P,K	2.1	100%
Corn, grid average	P,K	2.1	0

Source: Swinton and Lowenberg-DeBoer, JPA, 1998.

because costs can be spread and because the system can take advantage of synergy among inputs. For example, having both the corn plant population and nitrogen rate optimized together will have a bigger impact than the sum of each optimized separately.

Whole field fertilizer recommendations, such as the Tri-State Recommendations used in Indiana, Ohio and Michigan, were designed as compromises that were acceptable over a broad range of conditions. They were never intended to optimize production on small areas within fields.

The trials on the Greg Sauder farm near Trimont, IL, (1995-97) overcame some of these problems. The trials were more integrated than previous efforts. Nitrogen, phosphate, potassium, and corn plant population were managed site-specifically. In addition, Sauder had done on-farm trials to determine optimal nitrogen rates and plant populations for the soils under his management. The Sauder trials showed a 15 bu./acre increase in corn yields with site-specific management and about $18/acre increase in net returns. This trial shows that precision ag technology can be profitable for corn and soybeans, but it does not demonstrate how common profitability will be.

Studies have demonstrated profits for some other precision technologies. A Purdue study showed a benefit of about $3/acre/year when lime is spatially managed in Indiana. For a producer who already owns a GPS with satellite differential correction, just reducing skips and overlaps in chemical and fertilizer application can be worth an average of $0.50/acre/year.

Widespread adoption of yield monitors suggests that producers find them valuable. Unfortunately, there is very little data to document that value, because yield monitor information is used mainly at the whole farm level. For instance, if a producer uses a yield monitor to do hybrid strip trials and identifies the best genetics for that operation, those hybrids will be planted everywhere on the farm, not just in the field where the strip trial occurred. To measure the benefits of yield monitoring, economists would need whole farm records, and those are much more difficult to obtain than the on-farm trial results often used for evaluation of variable rate fertilizer.

Examples are often used to justify yield monitor use. For example, if a producer has 2000 acres of corn and soybeans, purchases a yield monitor and GPS for about $7000, and uses that yield monitor information to choose hybrids and varieties, then a one bushel per acre increase will pay for the yield monitor and equipment in the first year.

Innovations Needed

In 2001, precision agriculture is in about the same position that mechanization was in the early 1920s. At that time tractors had proven their value for a few uses. Tractors were profitable for primary tillage on relatively large farms and belt driven stationary equipment, but the technology was not well developed for row crop cultivation or any machine that required power on-the-go. The complete phase-out of the horse for farm power required the development of tricycle-type tractors for row crop cultivation, power-take-off, rubber tires for farm equipment, and other innovations.

Predicting the future of technology with absolute accuracy is impossible, but the economic studies suggest that several innovations are needed before precision agricultural technology becomes standard practice:

- Integrated precision agricultural systems with standardized parts and information formats,
- Soil sensors to reduce the cost of soil testing,
- Low-cost high-resolution remote sensing to reduce pest scouting costs,
- Easy-to-use software for data analysis, and
- Ways for producers to pool data to make the most of their information.

Implications for Land Value and Leasing

In the past, a substantial part of the benefits of any new crop technology in agriculture was capitalized into land values. That may happen again with precision farming. Using the standard capitalization model, discounting land over an infinite life (Value of land = Annual income/discount rate), using a 10% discount rate, and assuming that all the extra income was attributed to land, the added value due to the $18/acre benefit found in the Sauder trials would be $180 per acre. Even though it is unlikely that all the benefits would be capitalized into land, it is likely that profitable precision ag technology will add upward pressure to land prices.

The typical land capitalization model assumes that the scarcest resource in the farm sector is land, and hence all income that does not go to pay for specific inputs (e.g., seed, fertilizer, labor) can be attributed to land. In the precision farming case that assumption may not hold, at least not in the initial stages of adoption of the technology. The scarcest resource for the precision farmer may be human capital, that is, the knowledge and skill required make the system work, especially the ability to analyze data and develop strategies that increase profits. If skill is the scarcest resource, more of the precision farming benefits will go to attract people with the necessary skills. This may mean higher salaries for the agronomist working for the local fertilizer dealer or higher incomes for those farmers who acquire the skills.

Precision agriculture technology will also increase the demand for rental land. Precision technology is essentially a way to automate management. It takes some of the functions that formerly occurred in the brain of the farmer and turns them over to a computer. This will allow one person to manage more land, more effectively. To acquire that land, many managers will bid more

aggressively on rentals, just as they did when mechanization, chemical weed control, no-till, and other automation technologies were introduced.

The technology may also alter rental agreements. In recent years many farmland rentals have shifted from share agreements to cash rental, which is easier for tenants with multiple landlords to manage and requires less agricultural knowledge on the part of the landlord. Precision technology may slow that trend by making share rentals more profitable and easier to manage for landlords and professional land managers. In the recent past, most of the yield-increasing technology in agriculture has required higher expenditures (e.g., hybrid seed, fertilizer, pesticides). In most traditional share rental arrangements, this meant that the landlord shared in these costs. Most of the expenditures for precision agriculture technology (e.g., sensors and other equipment, software, training) would be paid by the tenant in the traditional share arrangement. Many studies of variable rate inputs show that overall input use changes very little, though the distribution of those inputs in the field may be changed substantially. Thus, under many current share agreements, precision farming means higher revenue for the landlord, with little additional expense.

One perennial problem in farmland rental is finding a trustworthy tenant. Sensor technologies may make it easier for a share landlord to monitor production practices and yields. For example, "as-applied maps" can show sloppy fertilizer or herbicide application practices. Yield maps provide a means to verify yields. Remote sensing can provide landlords with yield maps and other information completely independent of the tenant.

"A few uses for precision agriculture technology have proven to be profitable, and more are likely to be developed."

Summary

A few uses for precision agriculture technology have proven to be profitable, and more are likely to be developed. As precision agriculture becomes common practice, some of those benefits will probably be bid into higher farmland prices. But initially the scarcest resource in this system is likely to be human capital, and a substantial part of the benefit will go to those who have the skills. To the extent that adoption of precision agriculture is slow, there may be a larger window for earlier adopters to benefit.

Precision agriculture is also likely to increase demand for rental land and make share rental relatively more profitable for the landlord. Precision technology essentially automates management and allows one person to manage more land, more effectively. Under traditional share rental agreements, most of the cost of precision farming is paid by the tenant, so landlords may receive yield increases with relatively little extra expense. Sensors and satellite imagery also can make it easier to supervise share rentals.

References:

Lambert, Dayton, and J. Lowenberg-DeBoer, "Precision Farming Profitability Review," Site-Specific Management Center, Purdue University, Sept., 2000, http://mollisol.agry.purdue.edu/SSMC/.

Lowenberg-DeBoer, J., and K. Erickson, eds, *Precision Farming Profitability*, SSM 3, Agricultural Research Programs, Purdue University, West Lafayette, IN, 2000.

Swinton, S.M. and J. Lowenberg-DeBoer, "Evaluating the Profitability of Site Specific Farming," *Journal of Production Agriculture* 11 (1998), p. 439-446.

Sources of specific data are available from the author.

More information is available at SSMC Web site: <http://mollisol.agry.purdue.edu/SSMC/>.

Weed Control Boards

Several Indiana statutes provide for weed control. The township trustee may take action to control weeds, bill the owner, and, if the bill is not paid, arrange for the amount due to be collected.

Weed control boards (WCBs) are permitted to deal with several of the farmers' problem weeds. Weeds under the WCB law include: Canada thistle, Johnson grass, bur cucumber, and, recently added, shatter cane. A 1998 survey found very few active WCBs.

The WCB law permits the county commissioners to provide for a WCB by ordinance, on their own initiative, or after receiving a petition for a WCB signed by at least five percent of the registered voters of the county.

A WCB must consist of (1) one township trustee, (2) one SWCD supervisor, (3) a representative of the agricultural community of the county, (4) a representative from the county highway department, and (5) a Purdue University Cooperative Extension Service Extension Educator serves in a non-voting advisory capacity.

When a WCB does exist, it has broad powers of enforcement for the control of specified noxious weeds. A WCB has the authority to: employ staff to assist with WCB enforcement activities, enter upon land after a 48-hour notice to inspect, hire custom operators to control weeds, if necessary, and to bill the appropriate party for the costs.

In a county with a WCB, a township trustee may defer to the WCB to take action where the trustee has identified real estate containing detrimental plants. However, the WCB is not obliged to perform a task that is already a duty of a township trustee, and may refer a weed control problem back to a township trustee.

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For more on weed laws, contact Gerald A. Harrison, Extension Economist, ph: 765-494-4216; toll free: 1-888-398-4636; E-mail: <harrison@agecon.purdue.edu>.

Possible Departmental Name Change (Please Respond)

The Department of Agricultural Economics is considering changing its name. Clearly the breadth of activities encompassed by the department is much broader than its current name. The same is true for many other departments of agricultural economics around the country, and many of them have changed their names to something they feel better reflects what they actually do. We are now in the process of considering alternatives, and would like to hear from you.

Why consider a name change? Many feel that the name agricultural economics is too confining. Our undergraduates asked us to change our name to something that is broader and reflects the kinds of jobs they actually get upon graduation. They feel that our current name inhibits recruitment of students and is not attractive to potential employers. Graduate students have reflected similar views.

What names have been considered? Literally scores of names have been tossed around in search of the ideal name. While most faculty and students feel a name change is needed, that's pretty much where the agreement ends, at least so far. So we decided to get input from the people we serve in the farm and business communities.

The name changes on our current set of finalists are as follows:

- Food and Resource Economics
- Food and Resource Business and Economics
- Food, Agribusiness, and Resource Economics

Generally one can use the words management and business interchangeably so there are several variants on the names in this list that make this switch. For example, instead of Food and Resource Business and Economics, it could be Food and Resource Economics and Management. One reason there is interest in getting business, management, or agribusiness in the name is that we are considered the number one department in the country in agribusiness, yet none of the terms associated with agribusiness appear in our current name. Why is the word agriculture not in any of the proposed names? Most people prefer the broader term food. In addition, much of the work we do is at the interface of agriculture and natural resources, so many want the term resources in the name. Also, whatever the department name, we will still be the Department of _____ of the School of Agriculture. So agriculture is still there – just in the school name instead of the department name.

So let us know what you think. You can indicate your preference among these choices on this tear out page or suggest something else if none of these appeal to you. Just tear out this page, express you view, and mail it to us. Alternatively, if you prefer, you can send your views by email to namechange@agecon.purdue.edu. Either way, we look forward to hearing from you.

Wally Tyner
Professor and Department Head

Cut Here

Choices for new department name (please indicate your favorite, or rank the options):

___ Food and Resource Economics
___ Food and Resource Business and Economics
___ Food, Agribusiness, and Resource Economics
___ Agricultural Economics (no change)
___ Other _____

Comments:

Return this questionnaire in an envelope to: Wallace E. Tyner; Purdue University; Department of Agricultural Economics; 1145 Krannert Building, Room 653; West Lafayette, IN 47907-1145.

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