RISK ANALYSIS FOR AGRICULTURAL PRODUCTION FIRMS: CONCEPTS, INFORMATION REQUIREMENTS AND POLICY ISSUES

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DISCUSSION OF MODERN INFORMATION SYSTEMS: IMPLICATIONS FOR RISK RESEARCH*

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A management information system is defined by Batte and others as a system which provides useful information to management. As a technological advance, it combines human and computer resources to perform a task. Technological change which qualifies as improvement should increase efficiency. This is usually either a reduction in production costs or in risk and uncertainty. Either of these result in greater efficiency and greater productivity of the economic system. When production costs are decreased, the technological change should result in an increase in quantity produced, or a reduction in the inputs required for the production process.

A modern information system should provide increased knowledge about expected production as one compiles data over time. Using Knight's definitions, risk being measurable variation and uncertainty being unknown distribution of outcomes, an information system should, as a bare minimum, shift the variation in production from uncertainty toward an area of risk. Often a major problem in the application of risk theory is understanding what the distribution is, and what the variance of a particular outcome is. In addition, if the information system is timely, as pointed out by Batte, the control of the production system can be improved to reduce variation, increase yield, or reduce input waste.

One information system might be a radio system which would provide detailed location data of a piece of machinery at all times. Perhaps this could be accomplished through the triangulation of two radio broadcasting towers and a receiver on a field implement. With this arrangement, it is possible to place a meter on harvesting equipment to gather yield data from all locations in a field. This information, overlaid with weather information, soil tests, and soil types could provide detailed analysis of the yield potential of each location in the field to provide an accurate and optimal fertilization recommendation. Using the same location indicator, it would be possible to fertilize for each location by automatically adjusting the spreading rate as the machine moves across the field.

This system should increase yields and reduce the quantities of wasted inputs used in the field. Looking at this information system from a risk point of view, we see that some uncertainty has been removed from the production process. The potential is also present for more accurately estimating the yield risk.

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An information system has an efficiency enhancing characteristic, in addition to providing important information to risk analysis that has often been missing in the production process. The use of computers in a management information system will provide the capacity for mathematical manipulation of information in a data bank, including risk preference information which, with a solution algorithm, could permit the risk strategy of the producer to be entered into the system. In the example above, the fertilizer spreader could be controlled to meet the farmer's risk preference. This could be adjusted on a year-to-year or field-by-field basis by the farmer. The field-by-field basis would meet the farmer's desire to use different risk strategies in different fields in order to spread risk through diverse management strategies, as mentioned by Olson. The year-by-year adjustments would meet the requirements of the farmer's changing financial situation as well as his required safety margin.

As pointed out by Batte, the result of technological increase has often been the pushing of the production process toward its limits of various resources. If this is entered after analysis by a deterministic analytical framework, it is possible to create a production process which is very risky. The uncertain inputs can bring about the total failure of a cropping system because the production process might, for instance, be decided on by assuming that all uncertain variables will occur at their mean.

It has been hypothesized, but not proven that the increase in technology as reflected in crop yields has resulted in significant increases in risk. I have worked with a 40-year time period of crop production data attempting to determine whether the yield risk in national production has changed. At this point, it appears that there has been an increase in variation but this increase is not statistically significant. As a sidelight, this argument is of significant interest to those who are following the ongoing debate between agronomists and agricultural economists.

Economic theory indicates that as the technology increases, there is no significant reason to expect the variation in the production process to change. The agronomist would put forth the concept that there are limits to biological processes and that as one pushes the production process toward those limits, quantity produced becomes less dependable. Agricultural economic theory with its three stages of production indicates that distribution of expected yield depends upon where in stage two the new technology is optimized. Using Batte's terminology, if those inputs which are uncertain are close to the border of stage three, one would expect much lower variation. If one ascribes to the principle of the conservation of matter and energy and the resulting hypothesis of the linear homogeniety of the production function, then one would expect the decision inputs to be at the beginning of stage two.

There is no doubt that the significantly decreasing costs of computerization are resulting in the rapid increase in the number of computers used in agriculture. Most of these computers are special function computers, such as automated feed mix, carburetion for internal combustion engines, regulators for heat in the production processes and production facilities, etc. A significant problem in establishing widespread use of management information systems is the movement from these monitoring and response control devices to a bonafide data base system in operation. One must first determine which data are worth preserving and how to use them.

The data base, as pointed out by Batte, is a prerequisite of a meaningful management information system. The most discussed management information system is the financial accounting system. Farm financial records, uniformly decried by extension economists as seriously lacking in almost all agricultural operations, are indeed a problem. The significant constraint on the improvement of this data system is the time cost of improving it. At this point, the computerized accounting packages available are not very effective in reducing the time required for record keeping. This is an area which would greatly help in the farming operation and would be of value in planning for the agricultural firm. Planning is often quite removed from the control process, the process in which the data must be gathered in the production process. The genius of the next few years will be the individual who determines how one can keep a good set of books with a computer in less time than a bad set of books can be kept by hand. Another option would be to integrate the bookkeeping system with the control system to a point where the maintaining of the records is considered essential to the ongoing production process by the producer so that the records will be kept. An important possibility in this area would be a management information system for idle funds management. Cash flow management, which ensures that the operation is following a specified implementation plan, would be a valuable tool, but there has been no widespread adoption of this plan to date.

One of the more demonstrated uses of management information thus far has been expert systems. Expert system analysis is quite evident in the AGNET computer system and in many of the microcomputer decision aid packages available. The expert system, as pointed out by Batte, is an "algorithm which allows a problem to be addressed much in the same way as a human expert would seek a solution." The AGNET system essentially gives the user a list of programs which it can run--in essence, saying "In what area do you have a problem?" If an individual has a problem putting together an amortization schedule for an investment, the individual simply says "Amortize." The computer responds, "Would you like a description of the program?" If the answer is yes, a description is provided. This is quite similar to a person calling an expert on the phone and saying "I'm interested in knowing how to do an amortization table or interested in getting an amortization schedule." The expert either says "I'll be happy to help you or I don't know what amortization is." In this respect, the AGNET system is similar to the expert. Next the expert would probably say something like "Do you understand what amortization really is?" If the person says, "No, I'd like a better explanation." the expert would explain the amortization table, how it is derived and what information is needed. Later the expert would probably mail out an amortization table to the person making the inquiry.

An individual with a microcomputer will have a list of programs that are available on the microcomputer. When faced with a need for information from one of these programs, it will be used. In some ways this significantly duplicates on a conceptual basis the AGNET situation. However, those of us who are strong AGNET supporters should quickly point out that there is a significant difference between the types of expert systems that should be available on AGNET and on microcomputers. AGNET expert system programs should be those that change over time and those in which timely information is very important to the producer. The least cost ration of TELPLAN in Michigan, a management information system of a similar class, has been acclaimed to be saving several million dollars per year for dairy farmers in Michigan. This is a simple but dramatic example of the value of the management information systems.

I would like to emphasize Batte's point that a major problem in risk analysis has been the inability to deal with the combination of the complexity of the business operating environment, the quantification of diverse risk and the many options that are possible. If computerization and management information systems provide any salvation for this dilemma, I am convinced that it will be in the area of simulation of the production operation. The requirement is that the simulation be sufficiently complex to provide information of value to the operator and at the same time be simple or efficient enough in operation that the costs are not too great.

The concept of simulation is becoming an interesting mixture of the expert system and the farm data base information system to provide specific application information for the operation. Thus, the distinction between these categories will decrease in the application phase. A current example of the use of the implementation stage, as defined by Batte, is the Redwing package called the Crop Model. This is a financial simulation in which the user inputs the initial balance sheet, the budgets for different operations, and their time limits. The package provides cash flow statements and ending balance sheets for any combination of the inputs or enterprises that the farmer wishes to simulate.

Batte has summarized the situation quite well in his statement that the primary contribution of management information systems to agricultural production is going to be in the provision of more accurate data. I would also like to emphasize his statement that the crying need at this point is for software. This is the area in which we have the most fertile opportunities for research.

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