INTEGRATING EXTENSION EDUCATION AND ON-FARM RESEARCH

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ABSTRACT

This paper reports on an integrated extension project that combines an advanced crop production management educational program with on-farm research comparisons of alternative crop production technologies. The objectives of the project are to help producers determine the most profitable production strategies for their farm and to increase the effectiveness of technology transfer from research to adoption. The producer participants utilize farm records analyses and replicated on-farm comparisons to evaluate strategies for their farms. The trials are conducted using standard field equipment. The benefits and costs of the project were evaluated using a present value model. The analysis showed an internal rate of return of 28% for a group of 40 participants in the project. This represents a significant return to extension efforts even though only a limited number of producers may participate and significantly increases the rate of adoption of new technology.

INTRODUCTION

Crop producers' needs for information on production technology, management, and marketing continues to increase. At the same time, recommendations based on university research are often questioned due to their applicability for individual producers. Research is typically segmented by discipline but producers must incorporate it into a total crop management system. They need research that produces valid information on the performance of various components within a system and on the interaction of the components in a system.

Research results from experiment stations often result in slow adoption of technological changes as producers assess the adaptability of the research to their farm conditions, Ruttan et al. (1980).

This paper describes an integrated extension project that combines an advanced crop production management educational program with on-farm research comparisons of alternative technologies. The Nebraska Soybean and Feed Grain Profitability Project (NSFGPP) was developed to determine the most profitable production strategies for individual producers and to increase the effectiveness of technology transfer from research results to producer adoption.

BENEFITS OF ON-FARM RESEARCH

The role of on-farm research in evaluating new production practices has been well documented by Exner and Rosemann (1990), Francis (1990), Franzluebbers et al. (1988), and Rzewnicki (1991). On-farm research has been proven to provide adequate statistical precision to test a new technology for possible adoption. On-farm, field length strip plots provide more credibility to producers than experiment station plots.

Research which compares alternative production practices or technologies is conducted with a specific set of management practices and local conditions. On-farm research eliminates two major sources of possible variation in research results, namely, the inherent growing conditions such as soil type and the management system applied to the production technology.

Another major benefit of on-farm research is the cost effectiveness. This has two dimensions. Farm production costs are increasing and profit margins continue to be squeezed. Producers must select alternatives that have a high probability of financial success and make the most effective use of operating capital. On-farm research offers this advantage. In addition, on-farm research combined with an analysis of production costs allows the producer to select the most profitable strategy for their farm to gain knowledge of new production practices with a limited financial commitment. Field comparisons allow full use of land and the added cost of field operations is minimal.

COMPONENTS OF THE PROFITABILITY PROJECT

The three major components of the Profitability Project are the farm records analysis, the education program and the on-farm research. The benefits of the on-farm research are captured by combining the research project with an integrated educational program and a comparative analysis of costs for the trial on the producer's farm.

Farm Records Analysis

The analysis of a participant's crop production records is used for three purposes:

1. To Identify Research Topics. In year one, the farm records analysis establishes the foundation for the on-farm research. Producers provide three years of information on purchased inputs, equipment inventories and production practices. When compared to group averages for farm records projects and cost estimates from published budgets, the analysis can provide suggestions on limitations to profitability and possible areas of research.

2. To Evaluate the Research. Once research topics have been determined and research trials initiated, the farm records analysis provides the means for analyzing the production alternatives. Agronomic results of the research are combined with the cost data to provide an economic analysis of the strategies being studied. An evaluation of the alternatives in the trial is made in a consultation with each participant following each harvest.

3. To Analyze the Costs of Production. Providing producers with cost of production information is an important step in helping them improve their marketing programs. The farm records analysis allows producers to make rational decisions concerning marketing with knowledge of price levels necessary to meet personal marketing goals.

Educational Program

The educational program complements the on-farm research. It recognizes the need for progressive learning and incorporates a number of methods to accomplish this objective. A number of meetings are held each year focusing on economics and marketing, soil management, cultural practices and pest management. Tours of the on-farm comparisons as well as tours of other research activities, equipment demonstrations, industry tours, and business and governmental visitations are conducted.

On-farm Research

The on-farm research component demands a scientific approach to analyzing alternative production strategies. Based on knowledge gained from the farm record analysis and educational program, producers determine an alternative production system or strategy to compare against their standard or current system of production. When a specific comparison has been identified, an experimental protocol is developed, defining treatment strategies to be studied.

Once the research comparisons are established they are monitored for agronomic responses and data such as plant populations is collected periodically . Detailed yield data is collected at harvest. The structure and design of the comparisons are reviewed annually during the three year project period. Adjustments are made if the project proves to be infeasible.

PROJECT PERSONNEL and ORGANIZATION

The project is a multi-disciplinary collaboration of personnel at the university and county level and individuals from the private industry. Extension educators, located in county extension offices, are the primary link between the University and area farmers interested in participating in the project. The county educators are responsible for initiating the organization of project groups including recruiting producers and private industry cooperators. They are also responsible for coordinating all the local activities and maintaining communication with the participants.

One of the most intriguing and unique aspects of the NSFGPP is the participation of private sector cooperators. These individuals are professional agronomic and management consultants and provide their services on a volunteer basis without remuneration. Their primary responsibility is to provide leadership for the on-farm comparison. This includes monitoring the planting of the trial and ensuring the yield data are collected correctly. The private industry cooperators also assist with the records analysis and group activities.

Extension specialists located at the university provide leadership and guidance in the development of the educational program. They also provide guidance in establishing the protocol for the on-farm comparisons and assistance with the analysis of the research results.

Participants sign an agreement to participate in the project for a period of three years and pay an annual fee of $150. The producers provide all the crop inputs, management, and field operations necessary to establish and harvest the on-farm comparisons. They are also responsible for interacting with university personnel, the private industry cooperators and the other participants in the project on the practices followed and their interpretations of the results. This interaction and transfer of information is an important goal of the project.

The project was initiated in 1990 with an initial group of 12 participants in one county. In 1995, the project will have approximately 35 participants in five counties including six participants from the original group who re-enrolled for a second trial.

ON-FARM COMPARISONS

Originally, the project focussed on soybeans and all the comparisons were with soybeans. As the project expanded geographically, there were inquiries from producers who had more interest in research with corn and grain sorghum and in investigating strategies that involved crop rotations. Following is a list of the types of on-farm comparisons that have been conducted:

- Reduced tillage versus conventional tillage
- No-tillage versus conventional tillage
- Narrow rows versus wide rows
- Two plant populations
- Pre- and post-emergence herbicide treatment versus preplant-incorporated herbicide treatment
- Indeterminate versus determinate soybean varieties
- Reduced versus standard herbicide rates
- Biosolids (municipal sludge) versus anhydrous ammonia
- Early versus late planting date for soybeans
- In-furrow deep ripping (aeration) versus none

Pelleted lime versus no lime

Full rate versus three-fourths rate rootworm insecticide

Pre-emergence versus sidedress nitrogen

No-till corn versus no-till grain sorghum on soybean stubble

Alternative marketing strategies

A number of these comparisons have been conducted by more than one participant. Most of the comparisons were conducted on soybeans. The marketing comparisons are being conducted by two of the participants who re-enrolled for a second three-year period. After their first comparison they were more interested in conducting a marketing study for their soybeans rather than a production comparison.

ANALYSIS OF PROJECT BENEFITS

Benefits from the project accrue from the adoption of tested technologies that are profitable. They occur primarily due to quicker adoption by participants than non-participants. The benefits will be generated on all acres of that crop that the profitable technology is subsequently applied to. The length of the payoff period is the length of time the new technology provides increased economic returns or until the additional return from the new technology depreciates to zero. This payoff period exists only over the time interval after project participants have adopted the technology and before non-participants have adopted. For purposes of project evaluation, this economic life was defined as the length of time it takes for non-participants in the project to achieve 99 percent adoption of the most profitable technology.

An analysis of the project was made based on the results of the initial set of trials that were conducted. The results indicated that conservation tillage, post-emergence broadleaf weed control, narrow rows and reduced populations were profitable. All these trials were conducted with soybeans. The benefit-cost analysis was conducted using these four types of trials. The variety trials did not show any significant difference in yields or costs.

The benefits for this analysis were then estimated by using the following procedure:

1. The economic advantage of the alternative strategy being compared with the standard practice was calculated.
2. The length of the payoff period was estimated by comparing the adoption rates by the project participants with the adoption rates of the same technologies by a control group of producers in an adjoining county.
3. The average size of enterprise that the technology would be applied to was calculated from the a survey of the project participants and the survey of the control group of producers.
4. The present value of these benefits for an individual farm over the economic life of the technology was then calculated.

These benefits were then compared to the costs of conducting the on-farm research and the associated activities.

PROJECT COSTS

Grant funds were secured to initiate the project and hire a graduate student to coordinate the project for the first three years. Following is a summary of the annual costs for the first three years of the project:

University and county extension	
Faculty time and coordinator's salary	$65,000
Overhead and operating cost	7,000
Private industry consultants travel and operating costs	$200 per person
Participating producers	$150 per operation

The cost of the project has been reduced after the initial three year period. Current annual costs for a group of 10 to 15 participants are estimated below:

University and county extension	
Faculty time	$15,000
Overhead and operating	5,000
Private industry consultants travel and operating costs	$200 per person
Participating producers	$150 per operation

The maximum number of participants a private industry cooperator is able to work with is five or six.

The operating costs can vary considerably depending on the activities related to the educational component of the project. For example, transportation costs for business and industry visits will add to the costs. These types of activities are not an essential component of the project but have been a used to supplement the educational activities and give participants a broader perspective of the processing, transportation and marketing segments of the grain industry.

RESULTS

Net benefits were calculated for different sizes of project groups for different discount (interest) rates. The analysis can then proceed to either calculate the internal rate of return for a given project size or determine the critical project size necessary to equate project benefits with project costs for a given discount rate. The internal rate of return for a project size is the interest rate that equates project benefits and costs.

The results of the present value analysis are shown in Table 1.

Table 1. Net Present Value of the Nebraska Soybean Profitability Project.

Discount rate	Project size (number of producers) Net present value ($ Thousands)				Critical size (number of producers)
	40	80	120	160	
5%	572	1,330	2,100	2,860	10
15%	201	576	952	1,330	19
25%	32.3	227	422	616	34
35%	-52.4	47.6	148	248	61
45%	-98.0	-51.8	-5.74	40.4	125
IRR(%)	28.1	39.1	44.51	47.8	

Note: Critical size calculated for given discount rate. Internal rate-of-return (IRR) calculated by iteration for given project size.

The data show the net present value of the benefits of the project for a group of 40 participants at a discount rate of 15% was $201,000. The present value of net benefits for the 40 participant size for a 25% discount rate was $32,300 and for a 35% discount rate was -$52,400. Hence the rate at which the net benefits were zero was between 25% and 35%. By iteration this was calculated to be 28.1%. An alternative interpretation is that the investment of the combined costs of the project showed a rate of return of 28.1% if the group size was 40 participants. If the number of participants had been 80, this rate of return would have increased to 39.1%.

It is also possible to calculate the net present value of the research on a per acre basis. These results are shown in Table 2. At a discount rate of 15%, the average benefit of the on-farm research is $27.23 per acre.

Table 2. Net Present Value of On-farm Research.

Discount rate	Net present value of research ($/acre)
5%	49.30
15%	27.23
25%	16.73
35%	11.12
45%	7.82

Note: Net present value of research per acre averaged over all four profitable production practices adopted by producers.

CONCLUSIONS

The NSFGPP requires producers to make a three year commitment to the project in order to generate reliable results from the on-farm research comparisons. Three years is a minimum required for this type of project. A five year commitment would be preferable from an agronomic point of view as significant weather variability is inevitable. There are however, trade-offs in the time commitment. While a longer period than three years would increase the reliability of the results, the three year period increases the flexibility of the participants.

Experience from the project indicates the producers are comfortable with three years' results in determining which alternative they will adopt for their farm.

The NSFGPP has demonstrated the impact that an integrated research and education system can have on technology transfer. Producers benefit from participation in the project by gaining knowledge of new technologies, testing the applicability of the technologies to thier local conditions, and adopting the technologies that are the most profitable for their farms.

The integrated approach followed in the project requires a significant commitment from all the personnel involved. Even with the institutional support from extension specialists and county extension educators, the project could not exist without the contribution of the private industry cooperators. They provide invaluable service in facilitating the on-farm research component of the project.

The calculated returns represent a significant return to increased extension efforts aimed at a limited number of participants. Larger project sizes increase the net present value and the corresponding rate of return. The larger size allows the basic fixed costs of the university personnel to be spread over a larger number of acres of potential application of new, profitable technologies.

The results demonstrate the advantages of allocating extension resources to integrated, focused projects like the NSFGPP. Traditional extension efforts that are segmented by discipline fail to take advantage of the synergistic impacts of combing research and application at the farm level based on profitability. The potential gains demonstrate the need to focus the limited resources available on integrated, comprehensive programs.

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