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Farm Management Innovators: Characteristics of Eastern South Dakota Farm Operators

Douglas Franklin
South Dakota State University

Abdirizak Ahmed

FARM MANAGEMENT INNOVATORS:
CHARACTERISTICS OF
EASTERN SOUTH DAKOTA FARM OPERATORS

by

Dr. Douglas Franklin and Abdirizak Ahmed*

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ABSTRACT

Sustainable farming and reduced or low tillage are the technical and management innovations examined in the paper. A stratified survey of producers in a six county area of eastern South Dakota was conducted. The specific characteristics examined are operator age, education, gross income, percentage of rented land and cropping acres. The paper analysis the adopters and non-adopters of such technical and management innovations on the farm.

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* Franklin is an Assistant Professor of Economics and Ahmed is a former Graduate Research Assistant of the Economics Department at South Dakota State University, Brookings, South Dakota.

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INTRODUCTION

Farm crises in the 1980's had great impacts on United States farms including those in South Dakota. Rising input prices and interest rates, and reduced demand in export markets were a factor in financial stress to the farming environment. The rising debt of farms increased bankruptcy filings from 36 in 1980-81, to 241 in 1984 and 564 in 1986 in a state which has 35,000 farms and ranches (Janssen and Schmiesing, 1987). The problems were caused by a number of factors including fast growing agricultural production and slow growing domestic demand. Advances in agricultural machinery and biochemical engineering and available capital stimulated the rapid rate of growth of agricultural output which reached record levels in the late 1970's and early 1980's.

In the 1990's agriculture is faced with overproduction, increased production costs and more competitive export markets. Farms are becoming larger and more specialized. Between 1969 and 1982, the number of farms in the United States with annual sales less than $100,000 declined by 21 percent while the farms with annual sales of more than $500,000 has increased by more than 53 percent (Phillips, 1985). In South Dakota between 1965 and 1987, the number of farms decreased from 52,000 to 35,000 while the average farm size increased from 877 acres to 1266 acres (U.S.D.C., 1989). Family farms are complex, specialized and capital intensive business enterprises depending heavily on world markets, changing economies and political policies. Crop production reports of

Argentina and Brazil can have greater impact on crop prices than domestic news events (Janssen, 1991).

The increased production didn't come without a price to the environment. Pollution of the water table and streams with toxic chemicals and excessive loss of soil became a reality to deal with. Those problems created a need to find alternative methods to reduce the cost of production without compromising the production level. Thus, in a market characterized by a highly inelastic demand and slow growth, technical change becomes more visible either to reduce cost of inputs or increase total output. Since most of the gains in technical change create a lower cost per unit of production, only early adopters lower their cost and increase profits (Phillips, 1985).

The traditional approach to innovation diffusion assumes all individuals have an equal opportunity to adopt the new technology. In contrast, the market and infrastructure perspective to innovation diffusion takes the stance that the opportunity to adopt the new technology is in many cases purposely unequal with constraints set and controlled by government and private institutions (Brown, 1981). The farm subsidy policy and the market for organically grown products will dictate the trend of adoption of nonconventional practices as much as the individual farmers. Alternative farming practices gained more attention due to the farm crisis and greater awareness of environmental issues. The agricultural community began to raise questions about the impact of soil erosion and increased chemical uses on sustained productivity.

This report deals with the adoption of technical innovations and management practices on South Dakota farms. Technical innovation is a practice perceived to be a new or different method from the existing practice. Sustainable farming and reduced or low tillage as a management tool are the technical and management innovations examined. The reduction or elimination of chemicals on the farm is a major difference that sustainable farming has compared to conventional practice. It is an innovation to the existing method and has gained much interest in recent years. Sustainable farming is a farming practice designed to drastically reduce, preferably to eliminate, the chemical pesticides and inorganic fertilizers that are key elements of conventional farming by substituting crop rotation and cultivation for pest control and manure legumes, crop residue and other organic waste for plant nutrients (Crosson, 1989).

Changes in the tillage practices of American farms have also occurred in recent years. The moldboard plow despite it's longstanding popularity among farmers, has been criticized for wasting energy, reducing soil fertility, and contributing to soil erosion (Bultena and Hoiberg, 1983). The reduced or low tillage practice became the alternative to remedy those problems. Reduced tillage, sometimes called ecofarming is a system of controlling weeds and managing crop residue throughout a crop rotation with minimum use of tillage so as to reduce soil erosion and production costs, while increasing weed control, water infiltration, moisture conservation and crop yields (Wicks and Fenester, 1981).

Objectives

The major objective of this report is to compare the characteristics of adopters and non-adopters of alternative farming practice in South Dakota farms. The hypothesis is the adopters will have characteristics of being younger, more educated, with greater income and farm more acres. A specific objective is to determine the characteristics of adopters of sustainable farming and lowtill farming practices on South Dakota farms.

Methodology

The research utilized data from a survey conducted in eastern South Dakota counties. The intent of the random survey was to find the extent of alternative farming practices used on farms in South Dakota. The data from the survey was analyzed by using regression analysis. A logit model (Harrel, 1988) on PC SAS was used to find the probability of an operator using alternative farming practices (dependent variable) depending on the characteristics of the operator and farm (independent variables). The logit model was used because the survey data is qualitative. The dependent variable has only two outcomes of practicing or not practicing alternative farming (Yes or No). The logit model uses weighted least squares to smooth the non-constant variance that results when a model with a binary dependent variable is analyzed in ordinary least squares (Rubinfeld and Pindyck, 1989).

Previous literature on adoption and technical innovation on farms focused on different aspects of innovation. The use of a different tillage system and reduction of chemicals as a management tool are all considered as technical innovation. All of these bring changes to the prevailing farming practice by cost reduction and more efficiency to reach the desired objectives. Prior research on technical innovation focused on individual innovation rather than on a package of technical change on the farm.

Reduced or minimum tillage as a conservation tool has been extensively studied. Korsching, et al. (1983) examined personal, social and economic characteristics of adopters and non-adopters of minimum tillage from a sample of Iowa farmers. The means of adopters and non-adopters were compared to identify the significant factors that identify the adopters from the non-adopters. The adopters possessed the characteristics of being younger, more educated, operating larger farms, having higher gross income and owning more land than rented. These characteristics were significantly in agreement with the traditional approach of the adoption diffusion model.

Bultena and Hoiberg (1983) took a step further by including the potential of soil erosion on the farmed land as a factor on the adoption decision. The environmental characteristics of soil erosion potential has been overlooked by researchers because of the difficulty associated with getting reliable information about the terrain and the land soil erosion potential. The study compared early adopters, late adopters and non-adopters of minimum tillage in 23 counties in Iowa. The personal attributes of the operator, potential soil erosion, farm characteristics and the risk attitudes of the operator of the three categories were compared. The comparison showed that adopters were less risk averse, were younger, were better educated, had larger farms, had more potential for soil erosion and had higher gross income than non-adopters. The adopters fit the innovator characteristics of the diffusion model.

Rahm and Huffman (1984) studied the role that human capital and other variables such as soil characteristics, cropping systems and farm size had on the adoption of reduced tillage. The research focused the econometric differences in the farmer's decision to adopt reduced tillage and the efficiency of the farmers decision. The empirical results obtained showed that the probability of adopting reduced tillage differed widely across farms and depended on soil characteristics, cropping systems, size of farming operations and that the farmer's educational level helped in the decision making when the probability of adoption was not economically feasible. Thus, education of the operator was a significant factor in the adopter's decision making when all other factors are canceled out.

The term sustainable farming is not defined narrowly to have an exact meaning and reference. The term sustainable has other equivalent terms such as low input, alternative and regenerative. All point to the departure from traditional or conventional farming.

Prior research has defined sustainable farming as any method other than the conventional farming method of heavy emphasis on chemical and pesticide use on the farm. Most of the research on sustainable farming focused little attention on the comparison of the adopters and non-adopters of the method.

Baker and Smith (1987) studied the organic farmers of New York State. Although the number of organic farmers was very small in the state, they had separating demographic characteristics from the rest of the farming community. The organic farmers tended to be younger and more educated than the average farmer. Twenty percent of the operators were women which was three times higher than the state average and organic farmers operated smaller farms with smaller sales than the average state farmer. These characteristics set apart the organic farmers from the rest of the state farmers. Except for the age and education factors, they ran contrary to the traditional model of innovation diffusion.

Taylor et al. (1989) studied sustainable farming in South Dakota. The survey was on sustainable farmers, therefore, a comparison of sustainable and conventional farmers was limited. One factor from the study indicated the average age of the farmers was younger than the state average of all operators which gives the inclination to conclude, as innovators, the operators satisfied the criteria of the diffusion model.

RESEARCH DESIGN

A random, stratified survey of 304 farmers in southeastern South Dakota was conducted in August 1990. The survey covered six counties: Brookings, Deuel, Hamlin, Lake, McCook and Moody. The response rate was approximately 15.5 percent. The intent of the survey was to investigate the different management practices on

South Dakota farms. The survey asked specific questions on the use of reduced tillage practices and regenerative farming and general questions about the activities of the farm. The general questions asked about the operator and farm characteristics. The focus of this section was major crops, livestock or poultry inventory, irrigation methods, farm size, gross farm income, age of operator and the educational level of operator.

Survey Respondents

The total survey respondents were 47 of which 6 were unusable due to either the respondents no longer farming, in horticulture, or land rented out to others. The 41 usable surveys came from the 6 counties in the following percentage breakdown: 29 percent were from Deuel, 27 percent from McCook, 17 percent each from Brookings and Moody, 7 percent from Hamlin and only 2 percent from Lake. The characteristics of the respondents are given in Table 1. Table 1 also differentiates the respondents into three categories for comparison purposes. The following section highlights several characteristics of each category.

Characteristics Of Respondents

The 41 usable respondents had the following characteristics shown in column 2 of Table 1. The estimated average age was 52.5 which was higher than the state average age of 49.7 and the six county average age of 48.4 (USDC, 1989). The estimated average gross farm income was $166,554, which was higher than the state average of $74,761 and the six county average farm income of $94,073. The estimated average farm size was 736 acres, which was lower than the state average of 1,214 acres but higher then the six county average farm size of 587 acres.

Table 1. Characteristics of Respondents

Characteristic	All Percent	Conventional Tillage Only Percent	Regenerative AND Low Till Percent	Regenerative OR Low Till OR Both Percent
No. of Respondents	100	27	24.4	73.2
Age:				
less than 44	36	46	20	30
45 to 64	56	45	70	57
65 and older	8	9	10	13
Avg age (years)	52.5	53.5	53.5	51.5
Income:				
less than $99,999	41	67	40	38
$100,000 to $499,999	54	33	60	59
$500,000 or more	5	0	0	3
Avg income	$166,554	$78,525	$179,999	$178,499
Education:				
less than 12th grade	20	82	60	54
12th grade/post HS	66	18	30	33
bachelors degree	15	0	10	13
Acres Farmed:				
less than 400	22	55	20	19
400 to 799	37	27	40	39
800 or more	41	18	40	42
Avg acres farmed	736	634	800	826

Twenty seven percent of the respondents practiced conventional farming method only (column 3, Table 1). Even though 41 percent of the respondents had gross farm income less than $99,999, 54 percent of those (36 percent of all respondents) had gross farm income of less than $25,000. None of the respondents had gross farm income of $250,000 or more. The estimated annual gross farm income, $78,525, was smaller than the non-conventional farming practices.

Column 4 of Table 1 shows the 24.4 percent of the respondents practicing both reduced tillage and regenerative farming at the same time. Forty percent of the producers operated more than 800 acres of which 25 percent of those operated more than 1,600 acres but none had more than 2,000 acres.

There were 73.2 percent of the respondents practicing either reduced tillage or regenerative farming or both as shown in column 5 of Table 1. Three percent had income of one million or more and also operated more than 1600 acres.

The Logit Model

The analysis of the data used a multinomial logit model to study the determinants of the use of reduced tillage practices and sustainable agriculture. The logit method is more appropriate when the dependent variable has a binary or dichotomous result, in this case whether or not to use a farm management practice. The use of logistic regression instead of the general linear regression method is appropriate because of the nonlinear relationship of the dependent and independent variables. In nonlinear models at least one of the derivatives of the expectation function with respect to the parameters depends on at least one of the parameters. In linear regression the method used to estimate unknown parameters is least squares which yields estimators with a number of desirable properties but unfortunately, when applied to a model with a dichotomous outcome, the estimators no longer have the desirable properties. The linear regression model uses the maximum likelihood method for estimation to get the least square function.

The maximum likelihood yields values for the unknown parameter which maximize the probability of obtaining the observed set of values.

The logit model utilizes the maximum likelihood method in which the likelihood function in this case expresses the probability of the observed data as a function of the unknown parameter. The maximum likelihood estimators of these parameters are chosen to be those values which maximize the likelihood function. In a dichotomous situation where Y is coded as 1 or 0, the conditional probability that Y is equal to 1 given x, $P(Y=1|x)$ is $\Pi(x)$ while the probability Y is equal to 0 given x, $P(Y=0|x)$ is $1 - \Pi(x)$. Thus, the likelihood function for the pair (x_i, y_i) can be expressed:

$$\zeta(x_i) = \Pi(x_i)^{yi}[1 - \Pi(x_i)^{1 - yi}]$$

Since the observations are assumed to be independent the likelihood function is obtained as the product of the terms given in the expression as follows:

$$T(\beta) = \prod \zeta(x_i)y$$

using logarithms the log likelihood is:

$$L(\beta) = L[T(\beta)] = \sum \left[y_i \ln[\Pi(x_i)] + (1 - y_i)\ln[1 - \Pi(x_i)] \right]$$

To find the maximum likelihood estimates, β_0 and β_1, differentiate $L(\beta)$ with respect to β_0 and β_1 and set equal to zero. The use of weighted least square procedure and Newton-Raphson or use of iterative least squares, solves for a maximum likelihood estimator:

$$P(Y_i=1) = \Pi_i = \frac{e\ (\beta 0 + \beta_1 X_i)}{1 + e\ (\beta_0 + \beta_1 X_i)}$$

In which Π_i is constant for distinct values of X_i. Inverting this equation will yield the familiar log-odds or logit

$$L_i = \text{Log}\left[\frac{\Pi_i}{1 - \Pi_i}\right] = \beta_0 + \beta_1 X_i$$

This logit is linear in the parameters and L_i is a function of the factor X_i.

The Research Model

The logit model (Rubinfeld and Pindyck, 1989) is based on the cumulative logistic probability function and the probability that an operator will practice reduced tillage or sustainable farming is given by:

$$P_i = F(Z_i) = F(\alpha + \beta X_i) = \frac{1}{1 + e^{-zi}} = \frac{1}{1 + e^{-(\alpha+\beta Xi)}}$$

The change in P_i relative to a change in X_i is given by:

$$\frac{dP_i}{dX_{ij}} = \frac{dF}{dZ_i} \cdot \frac{dZ_i}{dX_{ij}} = f(Z_i)\beta_j$$

where $f(Z_i)$ is the value of the density function associated with each value of the underlying Z_i index. P_i is the probability that an operator will use either sustainable or low tillage practice. The characteristics to be studied are the farm operator's age, gross farm income, educational level of the operator, farm size and the number of acres rented.

RESULTS AND INTERPRETATION

The use of either sustainable farming or reduced tillage practices will be referred to as farm management innovation.

Though the two practices are different, their basic functions (the reduction of chemical usage and soil erosion) will have similar qualitative effects on the production cost. Since a percentage of sustainable farming operators use reduced tillage practices, it simplifies the analysis to group the two practices as farm management innovation. However, it is recognized that not all producers who adopt one practice automatically will adopt another practice.

Interpretation of the coefficient estimates in the logit model is rather more complex than the general linear model. The estimated coefficients take negative values, thus, in the general linear model the coefficients would have translated into a negative relationship between the use of farm management and the independent variables. But the logit model translates differently because of the log transformation of the parameters. The estimated coefficient must transformed from the exponential form to find the probability P(Y=1), which in this case is the use of farm management innovation. The probability that the operator will use farm management innovation is:

$$P(Y=1) = \frac{\exp(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n)}{1 + \exp(\beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_n X_n)}$$

This is the probability that a certain farm operator will use farm management innovation depending on the characteristics of income, age, farm size, percentage of rented acres and education. These characteristics were broken down into different categories making the model a regression with dummy independent variables. The specific modelling format is:

X_{ij} = Education of operator
Categories
i = 1, j = 1: if grade 1 through 8th, else = 0
i = 2, j = 1: if grade 9 through 11th, else = 0
Reference category: High school graduate or higher

X_{ij} = Farm size by acres
Categories
i = 3, j = 1: if 0 to 300 acres, else = 0
i = 4, j = 1: if 301 to 650 acres, else = 0
Reference category: greater than 650 acres

X_{ij} = Age of operator
Categories
i = 5, j = 1: if less than 35 years of age, else = 0
i = 6, j = 1: if 35 to 44 years of age, else = 0
Reference category: 45 years of age or older

X_{ij} = Gross farm income
i = 7, j = 1: if less than $25,000, else = 0
i = 8, j = 1: if $25,000 to $99,999, else = 0
Reference category: income of $100,000 or more

X_{ij} = Rented acres
i = 9, j = 1: if less than 25 percent, else = 0
Reference category: more than 25 percent rented acres.

Interpretation Of Table 2

The data shown in Table 2 are simple statistical standard deviations and means of each category. The mean of the categories pertains to all the observations in the survey and includes both conventional and alternative farming operators. Almost 27 percent of the operators were younger than 35 years, 17 percent were between 35-44 years old and almost 56 percent were older than 45 years. Seventy one percent of the operators had less than a 12th grade education and almost 20 percent had less than a 9th grade education. Forty six percent had less than $100,000 gross farm income and almost 15 percent had less than $25,000 farm income. Fifty nine percent rented more than 25 percent of their cropping land, 56 percent operated more than 650 acres and 17 percent operated 300 or less acres.

Table 2 Mean and standard deviation of characteristics

Variable	Mean	Standard deviation
Age		
less than 35 years	0.268	0.448
35 - 44 years	0.170	0.380
(reference 45 years or older)		
Education		
1-8th grade	0.195	0.401
9-11th grade	0.512	0.506
(reference H.school or more)		
Gross income		
less than $25,000	0.146	0.357
$25,000 - $99,999	0.317	0.471
(reference $100,000 or more)		
Farm size		
300 acres or less	0.170	0.380
301-650 acres	0.268	0.448
(reference 651 acres or more)		
Rented acres		
25 percent or less	0.414	0.498
(reference more than 25 percent)		

Interpretation Of Table 3

The results shown in Table 3 are the results of the logit analysis, the estimated coefficients and their probabilities. Most of the estimated coefficients take negative values, which do not translate into a negative relationship between the category and the use of either sustainable farming or reduced tillage because of the log transformation of the parameters.

Table 3 Maximum likelihood estimates of the logit analysis

Variable	Estimated Coefficients	Standard Error	Probability
Age			
less than 35 years	-1.878	1.69	0.944
35 - 44 years	-2.863#	1.77	0.863
(reference 45 years or older) ---------------->			0.992
Gross income			
less than $25,000	-2.930*	1.49	0.855
$25,000- $99,999	-0.012	1.29	0.991
(reference $100,000 or more) ---------------->			0.992
Education			
1-8th grade	-3.470#	1.87	0.775
9-11th grade	-1.898	1.49	0.943
(reference H.school or more) ----------------->			0.992
Farm size			
300 acres or less	-3.011*	1.48	0.845
301-650 acres	-1.632	1.54	0.957
(reference 651 acres or more) ---------------->			0.992
Rented acres			
25 percent or less	2.741#	1.45	0.999
(reference more than 25 percent) ------------->			0.992
Intercept	4.702*	1.96	0.992

* significant at the 5% level
# significant at the 10% level

The intercept value of 4.702 on Table 3 when transformed from exponential form yields a probability value of 0.992. This refers to the probability of practicing farm management innovation by the reference group, i.e. an operator with at least a high school education, 45 years or older, with a farm size of more than 650 acres, gross farm income of $100,000 or more and renting more than 25 percent of farm land.

Holding everything else constant in the reference group except one category of a characteristic, the change of the probability within the characteristic can be measured and observe whether the trend increases (decreases) and has a positive (negative) relationship with the dependent variable, i.e., the use of management innovation.

The estimated coefficient of 1st to 8th grade category of the education characteristics is -3.47 and the exponential value yields a probability of 0.775, while the next category of 9th to 11th grade has a probability of 0.943 and the reference category of the education characteristics has a 0.992 probability. The change in the probabilities implies that as educational level increases the probability of using farm management innovation increases. The percent of rented acres' estimated coefficient of the 25 percent or less category is 2.741 and yields a probability of 0.999, while the reference category or more than 25 percent has 0.992 probability, thus, implying that as the percent of rented acres increased the probability of using farm management innovation decreased.

The decision to adopt any innovation is usually made by the farm operator. Therefore, the operator characteristics of age, education, income, farm size and tenure influence the decision to adopt farm management innovations. The uncertainty associated with the use of a new method will depend on the operator characteristics of income and size of operation. Farm income and size should have greater impacts on the decision because if gross income is already small the operator may not be willing to take any additional risk. Thus, innovation adoption should be relatively low in low income categories. Farm size should have the same effect since the small size operator can not afford the risk associated with the expected yield, while an operator with a large farm, due to economies of scale, can survive the slight loss in the yield.

The factors of gross income and farm size show a positive relationship with adoption. As income and farm size increase the probability of adopting farm management innovation increases. This agrees with the findings of Bultena and Hoiberg (1983) who in their study of the factors affecting farmers adoption of conservation tillage in Iowa found that income and farm size play a positive role. The small size, low income operator cannot take the risk of losing a greater portion of income. An operator with larger gross farm income and larger farming acreage able to "practice or learn" the innovation in trial units prior to adoption on the whole farm. Therefore, an operator can more easily absorb a loss if the innovation is not profitable.

The correlation between income and farm size is usually strong and the degree of increase in the probability of the usage of farm management innovation should be almost the same. The use of gross farm income instead of gross crop production income creates a difference in the degree of change in the probability of using farm management innovation.

The personal attributes of education and age of operator were found to play a major role in the adoption of new farming practices. Previous studies have found that adopters of new farming practices tend to be younger and better educated then non-adopters. The younger and better educated operators are more knowledgeable about new farming practices, more receptive to risk taking and have more incentive to adopt innovation because of longer remaining payoff period (Bultena and Hoiberg, 1983).

The years of education increased the probability of using the farming practices. The hypothesis was the more education the operator has, the better equipped the operator is for the changing trends in farming practices to reduce excessive chemical use and avoid soil erosion. The age of operators showed inconclusive relationship with using farm management innovations.

Land tenure plays a role in the decision to adopt farm management innovation. Individual operators with similar land characteristics can reach different decisions on new practices depending on land tenure. Full owners are more likely to plan for long term investment, thus, have a greater probability of adopting farm management innovations. The percent of land the operator rents comes into the decision to adopt innovations. The more land rented, the less likely adoption takes place. The percentage of rented acres showed a negative relationship. As the percentage of rented land increased, the probability of adopting farm management innovation decreased. This agrees with the fact that the more land rented, the less the equity of the operator involved in the farming process. Thus, decreasing the inclination of the operator to be a better steward of the farm land and less likely to use reduced tillage or sustainable farming practices.

The classical regression model depends on the R^2 to measure the goodness of fit of the model. The logit model can not utilize the R^2 as a goodness of fit statistic for the maximum likelihood estimates, because of the binary dependent variable. The logit uses a log-likelihood score. The -2 log likelihood score of the logit model was 28.49 and had a chi-square value of 19.197 which exceeded the chi-square critical value with 9 degrees of freedom, and was significant at the 2 percent level. The significance level of 2 percent implies the rejection of the null hypothesis that all estimated coefficients are zero.

The other measure of the goodness of fit of the logit model involves an in sample evaluation of the predictive power of the estimated model shown on Table 4.

Table 4 **CLASSIFICATION TABLE**

		PREDICTED		
		Event	No Event	Total
OBSERVED	Event	25	5	30
	No Event	6	5	11
	Total	31	10	41

False positive rate = 19.4 percent; Correct rate = 73.2 percent; Specificity rate = 45.5 percent; Sensitivity rate = 83.3 percent; False negative rate = 50.0 percent

The logit model uses a classification method which is the observed and predicted values based on a 50-50 percent classification scheme. If the predicted probability for an operator is 0.50 or more it is counted as an event otherwise it is counted as no event. A disadvantage to the 50-50 classification is that an operator who predicted at 49 percent would be counted as no event the same as an operator with 0 percent prediction.

The false positive rate of 19.4 percent is the percentage of observed operators who didn't use farm management innovations while the model predicted they would adopt (6/31). The false negative rate of 50 percent is the percentage of operators already practicing farm management innovations whom the model predicted would not adopt (5/10). The sensitivity rate of 83.3 percent is the percentage of operators practicing farm management innovation whom the model correctly predicted (25/30), while the specificity rate of 45.5 percent is the percentage of operators not using farm management innovations whom the model correctly predicted would not adopt (5/11). The correct rate of 73.2 percent is the percentage of operators which the model correctly predicted as either adopters or non-adopters of farm management innovation. It includes 30 of the 41 operators.

These statistics indicate that the logit model should be of significant value in explaining the factors that influence the adoption of farm management innovation, namely educational level of the operator, farm size, gross income and the percent of rented acres.

SUMMARY AND CONCLUSIONS

A study of characteristics of adopters of sustainable and reduced tillage farming in South Dakota was undertaken to determine if the trend of innovation adoption was similar to prior studies in other regions. Earlier research on sustainable and reduced tillage in South Dakota did not address a comparison of operator and farm characteristics of adopters to conventional farming practice. The operators who tend to adopt the change are considered innovators. Only innovations that are profitable are adopted, otherwise, why use the innovation if it causes a loss. The analysis indicated those operators having higher educational level, higher income, owning greater percentage of their cropping land and operating larger farms had the anticipated traits of innovators.

REFERENCES

Baker, B., and D. Smith. "Self Identified Research Needs Of New York Organic Farmers." Am J of Alternative Ag. Vol 2 (3) 1987.

Brown, L. "Innovation Diffusion:A New Perspective." Methuen & Co, New York 1981.

Bultena, G., and E. Hoiberg. "Factors Affecting Farmers Adoption of Conservation Tillage". J of Soil and Water Conservation. Vol 38 1983. pp. 281-4.

Crosson, P. "Commentary: What is alternative agriculture." Am J Ag Econ. Vol 4 (1) 1989. pp. 28-31.

Harrel, F. "The Logist Procedure." SUGI-Supplementary Library Users Guide. version V. SAS Institute, Cary, N.C. 1988.

Janssen, L., and B. Schmiesing. "Examination of Farm Bankruptcy: Debtors and Their Creditors." SDSU Econ Dept Res Rep 87-6 August 1987.

Janssen, L. "Family Farms: Forces shaping their future." SDSU Econ Dept Staff Paper 91-2. March 1991.

Korsching, P., C. Stofferahn, P. Nowak, and D. Wagner. "Adopter Characteristics and Adoption Patterns Of Minimum Tillage: Implications for Soil Conservation Programs." J Soil and Water Conservation. Vol 37, 1983.

Phillips, M. "Microeconomic impacts of emerging technologies." Am J Ag Econ. Vol 67 (5) Dec 1985. pp 1164-1169.

Rahm, M., and W. Huffman. "Adoption of Reduced Tillage: The Role of Human Capital." Am J Ag Econ. Vol 66 (4) Nov 1984. pp. 789-792.

Rubinfeld, D., and R. Pindyck. "Econometric Models and Economic Forecast." McGraw-Hill, New York 1989.

Taylor, D., T. Dobbs, and J. Smolik. "Sustainable Agriculture in South Dakota." SDSU Econ Dept Res Rep 89-1 April 1989.

Wicks, L., and C. Fenester. "Fallow aids in winter wheat fallow rotation." Nebguide. University of Nebraska. G 81-546 1981.

U.S. Department of Commerce. "1987 Census of Agriculture: South Dakota". U.S. Dept of Commerce, Washington, D.C. 1989.