ADOPTION OF DOUBLE-CROPPING SOYBEANS AND WHEAT

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Abstract

Double-cropping of soybeans and wheat is often promoted by extension personnel. This paper seeks to explain how the decision to adopt double-cropping is made, using a Tobit regression model. Tobit makes use of more of the information in the data set than do logit or probit and explains not only the decision to double-crop but also the rate of adoption. The paper considers factors such as profit and risk perceptions and risk which have not been included in the past models used to explain adoption of technology. The results show that risk perception is important. Contrary to the findings of some other adoption studies, this decision in not influenced by human capital factors. The farmers who double-crop are more highly leveraged and appear to do so both to achieve higher income and as part of a risk diversification strategy. This is consistent with the importance of the location factor, measured as the average number of growing degree days at the farm's location. Growing degree days is a proxy for the actual distribution of returns from double-cropping and is the main factor explaining this decision. Extensive adoption of double-cropping in cooler regions of the Midwest must await technological advances that can increase the profitability of double-cropping by reducing the growing season for wheat and/or beans.

Key words: corn belt, human capital, risk perceptions, risk preference, Tobit

One technology which is of interest to Midwest farmers is double-cropping soybeans and wheat. Double-cropping works well with minimum tillage techniques, new short season varieties and newer and better chemicals which are all increasingly being used by Midwestern farmers. Its current attraction stems from several sources. Set-up costs can be low. Also, new technological improvements such as soybean growth regulators may be commercially available in the next few years (USDA). These would make double-cropping more attractive, especially if the beans could be planted into growing wheat prior to wheat harvest.

Beyond technical and economic feasibility, farm-related and human capital factors are usually investigated in adoption studies with widely varying results (see Feder et al.; Rahm and Huffman). Unlike most past studies, we make a distinction between the role of actual and perceived profitability and risk. Since farmers know less about the distribution of returns associated with new technology, subjective beliefs about profitability and risk are expected to be important factors in this decision. The role of an individual's perceptions of return distributions has not been measured and studied in a developed country adoption study and in only a few instances in the development literature (O'Mara; Goodwin et al.; Arcia et al.; Walker). Brink and McCarl assumed that double-cropping is riskier than a corn-beans rotation, but did not empirically measure risk perception or preference. This study also considers measures of farmers' risk preferences. Brink and McCarl (p. 263) concluded that "risk aversion is not, in general, an important factor in choice of crop acreages in the group studied."

Most past adoption studies have only tried to explain the decision of whether or not to adopt. This paper reports the results of an effort to empirically determine the factors affecting both the adoption and the rate of adoption of double-cropping by Midwestern farmers. This study uses a Tobit model which makes use of additional information in the data set to answer the question of the degree of adoption. The next section of this paper describes the double-crop decision. Then a theoretical model to explain adoption of double-cropping is derived. This is followed by a discussion of the Tobit procedure and the

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survey used to collect the data. The results of the statistical analysis are then presented, followed by the conclusions.

THE DOUBLE-CROP ROTATION

In the Midwest, double-cropping wheat and soybeans means adding winter wheat followed by late season soybeans to continuous corn, or winter wheat to a corn-soybean rotation. Double-cropping has been popular for some time in states to the south and southeast (Marra and Carlson). With depressed prices for all three crops, wheat alone would not be a promising crop alternative, but adding some wheat to acreage already in soybeans and corn may spread costs, allocate resources more efficiently, and reduce risk through diversification.

Double-cropping soybeans and wheat can lead to increased income if satisfactory soybean yields can be obtained. The length of the growing season is critical. Purdue agronomists indicate that beginning in late June, expected soybean yields decline about three-fourths (3/4) of a bushel for each day planting is delayed. For Indiana, Doster argued soybeans will generally yield a profit if planted before July 4th, which corresponds to test results in neighboring Ohio (Doster, 1984). The results from Ohio showed that selecting early-maturing small grain varieties, early harvesting of small grain and no-tillage planting of soybeans can lead to higher soybean yields and increased profit. Management practices that will help increase the likelihood of double-cropping being profitable are windrowing, drying early harvest wheat, expediting harvest by custom combining or baling, and no-till planting with narrow rows (Jeffers et al.).

Brink and McCarl argued that double-cropping involves considerable risk. Early harvest of wheat entails drying problems and possible labor bottlenecks affecting optimal timing of operations. Expediting planting as one moves north may necessitate minimum tillage and additional chemical costs. As with all new technologies there is conflicting evidence regarding the profitability and risk associated with double-cropping. The USDA reports that it is potentially profitable for all of Ohio and this should also hold for states that are latitudinally equivalent (Jeffers et al.). Location and the frost factor may be critical.[1] While this crop mix is attractive in the southern half of states latitudinally equivalent to Ohio, as one goes north, it becomes less profitable and more risky. Thus, locational factors are expected to be critical to the adoption decision, as are farmer's subjective perceptions of the distribution of returns and the risk characteristics of farmers.[2]

THE ADOPTION MODEL

The adoption model described below focuses on the decisions that farmers face at the beginning of each crop season. The decision to adopt an unfamiliar technology such as double-cropping involves considerable uncertainty and cannot be adequately analyzed within a profit maximizing framework. The objective of these farmers is assumed to be expected utility maximization which accounts for both expected profit and risk (Anderson et al.). One reason to adopt double-cropping may be to reduce risk by diversifying. Farmers are hypothesized to choose the cropping pattern (corn and soybean rotation or corn, double-crop soybeans and wheat rotation) or combination of cropping patterns they believe will result in the highest expected utility. Because of the technical constraints, farmers are expected to only double-crop a portion of their acreage.

Perceived differences can be measured by subjective distributions elicited from survey respondents. Rahm and Huffman, in their study of minimum tillage adoption, acknowledge the importance of the distribution of net returns, but treat the perceived distribution of returns as unobservable or unavailable. They go on to explain adoption solely by firm-specific characteristics such as farm size, soil type and cropping system. This study explicitly includes expected returns and variances along with risk preferences and farm and personal characteristics in the adoption model.

A farmer's decision problem is assumed to be

$$(1)\quad \text{Max EU}\ \{[\alpha P_1Y_1 + (1-\alpha)P_2Y_2]A - C(\alpha,A);\rho,g\}$$

where α is the percent of acres devoted to a corn-soybean-wheat rotation, P_1Y_1 is the net revenue per acre from a corn-soybean-wheat rotation, P_2Y_2 is the net revenue per acre from a corn-soybeans rotation, A is the fixed amount of land available, $C(\alpha, A)$ is the cost function, ρ is a measure of risk preferences, and g is a vector of farm and personal characteristics that affect the adoption decision. Marra and Carlson (1990) considered a similar theoretical model, but

[1] In western regions of the corn belt, adequate rainfall also becomes a restricting factor. Adequate rainfall is generally not a problem for the farmers sampled here.

[2] Non-adopters presumably perceive double-cropping as not profitable since some increased costs would be associated with double-cropping.

they did not include the human capital variables since they used state-level data.

If α^* denotes the optimal solution to the above optimization problem and is a function of P_1Y_1, P_2Y_2, A, ρ and g, as well as the joint probability distribution of P_1Y_1 and P_2Y_2, then $\overline{P_1Y_1}$ and $\overline{P_2Y_2}$ can be defined as the expected values and Σ as the second and possibly higher moments of the joint probability distribution function and thus,

$$(2) \quad \alpha^* = f(\overline{P_1Y_1}, \overline{P_2Y_2}, \Sigma, A, \rho, g).$$

Equation (2) is the basis for the empirical model, except that we seek to differentiate between actual and perceived differences in the joint probability distribution for P_1Y_1 and P_2Y_2. We do this because we want to determine if adoption could be increased by education to change perceptions. Since double-cropping is location specific, location as measured by average growing degree days is used to capture the true risk and returns associated with adopting double-cropping.

Risk preferences or attitude are also expected to affect this decision. If double-cropping is perceived to be a diversification strategy that reduces risk, a higher rate of adoption should be positively related to greater risk aversion. More risk averse farmers would be expected to adopt a risk-reducing technology.

Farm size is one farm characteristic considered Mara and Carlson (1987) and Just and Zilberman argue that the rate of adoption will increase with farm size at smaller farm sizes and decrease with increasing farm size at larger farm sizes. Debt position provides a measure of the ability to bear risk. If setup costs were high, a lower debt/asset ratio would be associated with increased double-cropping. But, since setup costs should be low, farmers might choose to double-crop to diversify and lower overall risk if they are highly leveraged. A high debt/asset ratio would then be associated with increased double-cropping.

Alternative risk diversification strategies may also be used by these farmers. One such possibility is off-farm income which could be negatively related to double-cropping because it can substitute for other diversification strategies. Off-farm employment could also take time away from farming that may be needed to achieve the degree of timeliness that would make double-cropping profitable.

The relation of human capital factors to adoption of new technologies is often not clear (Feder et al.; Luzar et al.). Human capital factors fall into two categories. Farmer characteristics such as education and experience, enhance allocative efficiency (Welch; Rahm and Huffman). In this regard, they should be positively related to adoption of new technologies. They may, however, be negatively related to adoption of new technology since experimentation may decrease with age and experience.

THE TOBIT PROCEDURE

Empirical models that have been used to study adoption include probit and logit. They only explain the probability of adoption. They fail to take into account the degree of adoption. This inadequacy is overcome with the use of the Tobit model (Tobin; Amemiya; McDonald and Moffitt). Since the dependent variable (a), the percent of acres double-cropped, cannot take on values below zero, it has a truncated normal distribution and the Tobit model is appropriate. The parameters were estimated by Maximum Likelihood using LIMDEP. Adopting the notation of McDonald and Moffitt, we can represent the adoption model as:

$$(3) \quad \begin{array}{ll} \alpha = X\beta + e & \text{if } X\beta > e \\ 0 & \text{if } X\beta \le e. \end{array}$$

The X vector of explanatory variables contains relevant elements of equation 2, β is the vector of coefficients and e is the independently distributed normal random error term with mean zero and variance σ^2.

The total change in α associated with a change in an explanatory variable X_i can be decomposed into the change in the probability of being above zero and the change in the values of α, if it is above zero. Elasticities, useful in comparing the relative magnitude of effects of significant variables on the total change in α, were calculated using the following derivatives outlined in McDonald and Moffitt.

McDonald and Moffitt showed that the expected value of all observations of the dependent variable (Eα) is equal to the expected value conditional upon being above zero (Eα*) and the probability of being above zero, F(z):

$$(4) \quad E\alpha = F(z)\, E\alpha^*.$$

They decompose the effect of a change in the ith variable of X on the expected value of α as follows:

$$(5) \quad \delta E\alpha / \delta X_i = F(z)\,(\delta E\alpha^* / \delta X_i) + E\alpha^*(\delta F(z)\, \delta X_i).$$

Thus, the total change in Eα is made up of two components: (1) the change in the expected value of

α for those observations above the limit of zero, weighted by the probability of being above the limit; and (2) the change in the probability of being above zero, weighted by the expected value of α, if above zero. The first component translates into the change in the rate of double-cropping for those who currently do so, weighted by the percent currently doing so, and the second component relates to the change in the percent double-cropping weighted by the current rate of adoption.

The effect of a change in X_i on $E(\alpha)$ is not equal to β (beta). Simplifying equation (5), it can be shown to be

$$(6) \quad \delta E\alpha / \delta X_i = F(z)\beta_i ,$$

where $z = X\beta/\sigma$. Evaluating at the mean of each X_i, the elasticities are calculated using equation (6).

We are also interested in the fraction of the mean total change in double-cropping that would be expected due to marginal changes by those who are already double-cropping and the fraction that would be generated by a change in the probability of adopting, i.e., the effect due to the likelihood of new adoption. This would give an indication of the likely effects of extension efforts to encourage adoption. McDonald and Moffitt show the first effect to be:

$$(7) \quad [1 - zf(z)/F(z) - f(z)^2/F(z)^2] ,$$

where f() is the unit normal density.

This is the fraction by which the β coefficients must be adjusted to obtain correct effects for observations above the limit. The second fraction is obtained by subtracting the result obtained from equation (7) from one.

THE DATA

Each year the Top Farmer Crop Workshop is held at Purdue University. Participants are introduced to innovative technologies and management practices to help them improve their farm businesses. Voluntary participation in such a workshop distinguishes these farmers as highly motivated to improve their management ability and be innovative. A questionnaire was administered at the August 1990 workshop to 54 farmers. How the factors that are hypothesized to have an effect on the decision to double crop were measured follows.

Farm size was measured as total acreage (TOTAC). The number of growing degree days at each farm location (LOCAL) was used to capture actual changes in the distribution of returns. Personal characteristics included age (AGE), years of formal education beyond high school (EDUC), years managing a farm (EXPER), and a discrete measure of self-assessment of managerial ability (MGTRATE).

A Pratt-Arrow measure of risk attitude, RISKAVR, was elicited using the risk interval approach of King and Robison and then transformed from a range to a discrete variable by using the midpoint of the range. How leveraged they are was measured by asking them to place their debt/asset ratio within a range. This variable, called DEBTPOS, was elicited to measure current ability to bear financial risk and was treated as a discrete variable.

The ratio of subjectively determined expected net returns from double-cropping to returns from a corn-bean rotation [$MR = E(P_1Y_1)/E(P_2Y_2)$] was included as a measure of relative profitability. Subjective distributions of future yields and prices were formed to measure perceived risk. Farmers were asked to construct frequency distributions using the fixed interval or judgmental fractile method (Raiffa). This involved considering the yields and prices they would expect over the next ten years since this information should be more appropriate to current decisions than historical data. Covariances among yields and among prices of the individual crops studied were also elicited and included in these calculations based on the derivations of Bohrnsted and Goldberger. This approach asks the producer questions such as how much higher than average would expect soybean yields to be when corn yields are 10 percent higher than average? The correlation between prices and individual producer yields was assumed to be zero since prices and county yields are usually uncorrelated. From these distributions, the standard deviation of perceived revenue was then derived for the corn-soybean rotation (SCS) and the corn, double-crop soybeans and wheat rotation (SCSW). These were the two crop mixes used by farmers in the sample. These were derived assuming they were approximations of the underlying normal distributions of expected prices and yields (David; Raiffa). A measure of perceived risk differences (SR) is the ratio of the standard deviation of farm revenue for the corn-soybeans rotation (SCS) to the standard deviation of farm revenue for the corn, double-crop soybeans and wheat rotation (SCSW). The climatic location variable is hypothesized to capture the differences in risk associated with climate. Thus, the variable SR is intended to measure differences in adoption behavior due to differences in perceived risk.

One possibly important variable that is not considered is the effect of government farm programs. In a past survey of farmers at the workshop, Shapiro and Brorsen found that 93 percent participated in farm programs. Since virtually all past workshop participants participated in farm programs we did not ask about farm program participation in our survey. Farm programs undoubtedly restrict the ability of farmers without any wheat base acreage to adopt double-cropping. Also, double-cropping is less attractive to farmers who participate in the wheat program because soybean cannot be grown on wheat set-aside acreage.

RESULTS

Table 1 presents the means of farm and personal characteristics of Midwest farmers participating in the Top Farmer Crop Workshop in August 1990. Thirty-two percent of the 53 farmers sampled double-cropped and had an average of 199 acres in this rotation. Adopters had 7.5 percent more growing degree days to take advantage of double-cropping. As a group, they tended to be slightly younger (three years), to have less experience farming (two years), and to be less educated (2.8 years of post-secondary education). A wide range of risk preferences was found in this sample; 45 percent were risk averse, 16 percent risk neutral, and 39 percent risk preferring. This is consistent with the findings of Wilson and Eidman and others. Adopters were more risk averse than non-adopters, with a mean risk preference of 3.62, as opposed to 4.56 for non-adopters.

Adopters of double-cropping perceived average future yields from rotation corn, rotation beans and wheat to be 8 percent, 7 percent and 10 percent lower, respectively, but yields from double-crop beans to be 13 percent higher than non-adopters. From the fixed interval distributions, ratios of gross revenue and the variance of gross revenue for double-cropping to a corn-bean rotation can be calculated. Adopters perceive double-cropping to lower risk by 5 percent and to increase total crop revenues by 8 percent. Non-adopters expect revenue to be only 2 percent higher from double-cropping, but risk to be 9 percent lower. However, the ratio of the coefficient of variation for expected corn-bean-wheat to corn-bean revenues was 0.88 for the group of adopters and 0.90 for non-adopters. Thus adopters perceive the relative risk from double-cropping compared to a corn-beans rotation to be 2 percent lower than do non-adopters.

Table 2 presents the variance-covariance matrix of net returns as perceived by adopters of double-cropping. Noteworthy is that the variance of double-cropped beans is lower than regular beans. This contrasts with the estimates used by Brink and McCarl that were based on experimental plot data for rotation beans with zero yields assumed every fifth year. They assumed that double-cropping is riskier.

The regression results presented in Table 3 include two alternative specifications of the Tobit model, with and without human capital variables. They

Table 1. Means of Variables from a Survey of Midwest Farmers, August 1990

Variables	Double-Cropping Non-Adopters	Double-Cropping Adopters
Number	36	17
Total Acres	1,662	1,717
Acres Corn	923	753
Acres Soybean (Following Corn)	611	628
Acres Wheat	45	257
Acres Double-Crop Beans	0	199
Risk Aversion	4.56	3.62
Growing Degree Days	2,656	2,856
Average Corn Yield	144	133
Average Bean Yield	48	45
Average Wheat Yield	67	61
Expected Double-Crop Yield	23	26
Age	41	38
Years Farming	18	16
Education (Years)	13.7	10.9
Off-Farm Income (% of Respondents)	39	35
Debt Position	3.0	2.8
SR[b]	0.92	0.95
MR[c]	1.02	1.08

[a]Variance of net revenue of a corn-wheat-bean rotation divided by the variance of net revenue of a corn-bean rotation.
[b]Ratio of the net revenue from a corn-wheat-beans rotation and net revenue from a corn-beans rotation.

Table 2. Variance-Covariance Matrix of Returns Estimated by Adopters of Double-Cropping[a]

Crop	Corn	Soybeans	Wheat	Double-Crop
Corn	15,604 [1.00]	4,085 [0.55]	16.5 [0.14]	2,656 [0.53]
Soybeans		11,569 [1.00]	8 [0.03]	6,596 [0.90]
Wheat			4,619 [1.00]	8 [0.04]
Double-Crop				5,656 [1.00]

[a]The number in brackets are the correlation coefficients.

indicate that adoption of double-cropping for this sample is significantly related to: (1) the climatic location factor, growing degree days (LOCAL), (2) perceived risk differences between double-cropping and a corn-bean rotation (SR), (3) the subjective assessment of debt/asset position (DEBTPOS), (4) whether or not there is off-farm income (OFFINC), and the (5) Pratt-Arrow measure of risk preference (RISKAVR). The relative magnitude of the effects of these factors is shown by their elasticities which are presented in Table 4.

The most important variable explaining double-cropping is the climatic factor, LOCAL (ε =11.82). Since weather is a key determinant of the actual distribution of returns, the importance of this variable indicates that these farmers are able to assess the technical and economic feasibility of double-cropping. The subjective measure of profitability, the revenue ratio variable, was not significant, even when LOCAL was dropped from the regression equation.

Beyond technical and economic feasibility, perceived risk differences between the cropping patterns (ε = 7.29) is an important variable related to this decision. Thus, the individual's subjective perceptions of risk provide information beyond that captured by differences in climate. This could result either from these farmers' having additional useful information or erroneous perceptions that could be changed by education.

The role of risk aversion in this decision is consistent with the importance of risk perception. The results indicate that the more risk averse these farmers are, the more they will double-crop. The effect of risk aversion on the rate of adoption, as measured by the elasticity, however, is relatively small (ε =1.37). Nonetheless, the results provide a contradiction to Brink and McCarl, who concluded that risk did not affect cropping patterns in their sample of Mid-west farmers. The sample of farmers is similar to that of Brink and McCarl, who sampled farmers from the same workshop. The results are, however, consistent with Brink and McCarl in the sense that other factors are more important than risk preferences.

The sign and significance (ε = -2.82) of the debt/asset ratio measure (DEBTPOS) indicates that the ability to bear financial risk affects this decision. This is also consistent with the reduction in portfolio risk perceived to be associated with double-cropping. Thus, double-cropping appears to be part of the diversification strategy used by those farmers who can double-crop profitably. Having a source of off-farm income (OFFINC) is inversely related to the decision to double-crop, but has a small impact on the adoption decision (ε =-0.74). This alternative activity apparently substitutes for double-cropping as a risk diversification strategy.

The results for model 1 indicate that human capital factors such as age and education are not important in this decision. This is also true of the subjective human capital variable, MGTRATE, which is a self-assessment of management ability. Human capital advocates, such as Schultz, Welch, and others, pro-

Table 3. Estimated Tobit Models to Explain Adoption of Double-Crop Soybeans and Wheat in Indiana Using Different Proxies for Risk Variables[a]

	Model	
Independent Variable	with human capital variables	without human capital variables
RISKAVR	-.0227 (-1.291)	-.0244[b] (-1.584)
TOTAL	-.00003 (-0.797)	-.0002 (-0.754)
DEBTPOS	-.0716** (-1.929)	-.0735** (-2.022)
AGE	-.0025 (-0.067)	
EDUC	-.0023 (-0.305)	
OFFINC	-.1572** (-1.902)	-.1498** (-2.031)
MGTRATE	-.0053 (-0.109)	
LOCAL	.00038*** (2.949)	.00033*** (3.188)
MR	-.1475 (-0.655)	-.1700 (-0.811)
SR	-.4995** (-2.296)	-.5124*** (-2.448)

[a]The numbers in parentheses are asymptotic t-values. One, two, and three asterisks denote significance at 10 percent, 5 percent, and 1 percent, respectively.
[b]The coefficient is significant at the 10 percent level using a one-tailed test.

Table 4. Elasticities of Model 2 to Measure the Total Change in the Expected Rate of Adoption Evaluated at the Mean of the Significant Independent Variables

Independent Variable	Coefficient	Mean	Multiplier	Elasticity
DEBTPOS	-.0735	2.9245	-.04025	-2.82
LOCAL	.00033	2720	.000182	11.82
SR	-.51238	1.0837	-.281809	-7.29
OFFINC	-.1498	0.3774	-.08239	-0.74

vide considerable evidence that education enhances allocative ability and efficiency in the disequilibrium caused by the introduction of new technology. In this sample of farmers, double-cropping is primarily used by younger, more inexperienced farmers who may be more in debt.

Farm size (TOTAC) had the expected positive sign but was not significant. This may have been due to a lack of variability in the sample but could also be related to low set-up costs associated with double-cropping. Double-cropping appears to be a technology that is reasonably scale-neutral across the range of farm sizes observed.

Decomposition of the mean total change in double-cropping due to marginal changes by those already double-cropping, using equation (8), shows this potential change to be only 16 percent. Marginal changes by those already adopting double-cropping are expected to be small. The potential effect generated by changes in the probability of adoption by those not currently doing so is then 84 percent. Whether those who are not currently adopting would become adopters depends on many factors. The results of this study show that the location-specific nature of this technology will have to be considered if increases in double-cropping are to be realized, and before changes in risk perception and other issues can be addressed.

CONCLUSIONS

This research sought to determine the factors that influence the adoption of double-crop soybeans and wheat by Midwest farmers. The Tobit regression model uses more of the available information in the data set and thus provided more useful information about this decision than logit or probit. Tobit provides a more powerful test of the significance of the variables hypothesized to affect this decision. Double-cropping is most influenced by the actual distribution of returns which was measured as the number of growing degree days. Beyond technical and economic feasibility that is conditioned by the weather, subjective beliefs about the potential distribution of returns from double-cropping also have an important influence on this uncertain decision. Education, which should improve decision-making ability, was not important.

Results provide evidence consistent with that found by Walker and O'Mara, that differences in perceptions may be more important than differences in risk preferences in determining the behavior of farmers. Although risk attitude is difficult to measure accurately, the double-crop decision can be said to be marginally related to the Pratt-Arrow measure of risk preference. This finding mildly contrasts with Brink and McCarl's research on Indiana farmers. They concluded that risk preference was not an important factor in crop mix choices. The sample displayed a wide range of risk preferences which differed by the question asked. This may be related to Young's contention that risk preferences differ by situation and level of risk.

Some extension agencies are advocating double-cropping as an alternative to a corn-bean rotation by Mid-west farmers. Further technological advances that will make the climatic constraint less binding may have to be developed before there will be much additional adoption of double-cropping in northern areas. Extension agencies advocating double-cropping should keep in mind that the length of the growing season dominates this adoption decision. Further adoption is not likely to occur in northern areas of the corn belt until further advances in short cycle soybeans are achieved or some means of lengthening the growing season is found. Efforts to promote double-cropping should be focused on non-adopters in the southern areas of the corn belt.

This study goes beyond previous adoption models in that it attempts to separate actual risk and returns as measured by climatic differences from perceived risk and returns obtained from the survey of producers. Differences in perceived risk, but not human capital factors were found to be significant in explaining adoption of double-cropping in this sample of Midwest farmers. However, location was found to be the primary factor affecting this decision.

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