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**The Effect of Economic Factors on the Adoption of Best Management Practices
in Beef Cattle Production**

Seon-Ae Kim, Jeffrey M. Gillespie, and Krishna P. Paudel

Dept. of Agricultural Economics and Agribusiness
101 Ag. Administration Building, Louisiana State University
Baton Rouge, LA 70803-5604

Tel: (225) 578-2595

Fax: (225) 578-2716

e-mail: skim7@lsu.edu , jmgille@lsu.edu and kpaudel@lsu.edu

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Abstract

Probit analyses were conducted for adoption of Best Management Practices (BMPs) and rotational grazing. Results show that more diversified farmers are more likely to adopt BMPs. Results for willingness to adopt rotational grazing show that higher bid offers would lead farmers to be more willing to adopt the system.

The Effect of Economic Factors on the Adoption of Best Management Practices in Beef Cattle Production

Introduction

Substantial research effort has been devoted to developing environmentally friendly practices so as to reduce the generation of pollutants from agriculture. Best Management Practices (BMPs) have been developed to achieve the goals of high agricultural productivity and a sound environment. Although BMPs have been developed and information about them has been distributed, adoption rates are not very encouraging, especially among cattle producers in Louisiana.

To encourage farmers to adopt conservation practices, the United States Department of Agriculture has developed programs such as the Environmental Quality Incentives Program (EQIP), the Conservation Reserve Program (CRP) and others. Through EQIP, farmers can receive technical assistance, cost-share payments and/or incentive payments when they implement conservation practices such as BMPs.

There have been few, if any, studies conducted on the adoption of beef production BMPs, although a number of studies have been conducted for the other agricultural commodities. Determining the cost-share rate at which producers would adopt conservation practices is important. When we know how much specific types of farmers are willing to pay to adopt a conservation practice, we will be able to better target adoption efforts.

The objectives of this study are to assess the extent of current adoption of BMPs in beef cattle production and determine the effect of factors on the adoption of BMPs. Furthermore, the study determines the effect of cost-share payments on willingness to adopt a rotational grazing system. In addition, the influence of demographic, socioeconomic and farm characteristics on the adoption of rotational grazing is examined.

Methods

Probit analyses were conducted to determine the factors that affect adoption of BMPs and willingness to adopt a rotational grazing system. Probit is a binary choice model commonly used to analyze the choice behavior of an individual facing two alternatives and opting for one. The probability p_i of choosing alternative A over not choosing it can be expressed as in equation (1), where Φ represents the cumulative distribution of a standard normal random variable (Greene, 2003).

$$(1) \quad p_i = \text{prob}[Y_i = 1|X] = \int_{-\infty}^{x_i'\beta} (2\pi)^{-1/2} \exp\left(-\frac{t^2}{2}\right) dt = \Phi(x_i'\beta)$$

The relationship between a specific variable and the outcome of the probability is interpreted by means of the marginal effect, which account for the partial change in the probability. The marginal effect associated with continuous explanatory variables X_k on the probability $P(y_i=1|X)$, holding the other variables constant, can be derived as equation 2 (Greene, 2003);

$$(2) \quad \frac{\partial p_i}{\partial x_{ik}} = \phi(x_i'\beta) \beta_k$$

where ϕ represents the probability density function of a standard normal variable.

The marginal effect on dummy variables should be estimated differently from continuous variables. Discrete changes in the predicted probabilities constitute an alternative to the marginal effect when evaluating the influence of a dummy variable. Such an effect can be derived from equation 3 (Greene, 2003).

$$(3) \quad \Delta = \Phi(\bar{X}\beta, d = 1) - \Phi(\bar{X}\beta, d = 0)$$

Data

A statewide mail survey¹ of 1,500 beef cattle producers was conducted during summer of 2003. The National Agricultural Statistics Service drew a stratified sample by herd size of Louisiana beef cattle producers. The size categories were 1-19, 20-49, 50-99 and more than 100. They constituted 26.7 percent, 23.3 percent, 23.3 percent, and 26.7 percent of the sample, respectively. For willingness to adopt a rotational grazing system, two different survey formats were used with split sampling. With 504 responses, the response rate was 41 percent after deducting 270 responses that were no longer in cattle business.

The survey collected information on production characteristics, current adoption of BMPs, future willingness to adopt a rotational grazing system under single specific bid offers, and farmer socio-economic characteristics.

A total of 369 beef cattle producers answered a willingness to adopt rotational grazing question. Potential respondents to the question included beef cattle producers who had not adopted a rotational grazing or those who answered they were using rotational grazing, but with less than five paddocks.

For willingness to adopt a rotational grazing system, beef cattle producers were asked, “Suppose that the total cost of establishing a rotational grazing system is \$50 per cow, including self-filled troughs, electric fencing, pipeline and labor charges for this installation. Suppose the federal government were to agree to pay X percent ($\$50 \times (X/100) = Y$ per cow) of the cost. Would you be willing to pay the remainder ($\$50 - Y$ per cow) to adopt it?” The chosen cost-share percentages were 60, 70, 80, 90 and 100. Half of the respondents received a dichotomous choice format questionnaire requiring either a ‘yes’ or ‘no’ response. The other half received a polychotomous choice format and had six different choices to choose from. Those were, “I

¹ Copies of survey are available by contacting the authors.

definitely would *not* adopt it,” “I *probably* would *not* adopt it,” “I would *slightly* lean towards *not* adopting it,” “I would *slightly* lean towards adopting it,” “I *probably* would adopt it,” and “I *definitely* would adopt it.” For the analysis purpose, these six answer choices were grouped into two, the first three were grouped into ‘no’ and the last three into ‘yes.’

Variables

Fifteen BMPs are listed and described in the bulletin, “Beef Production Best Management Practices,” published by the Louisiana State University Agricultural Center. However, Prescribed Grazing is split into two separate BMPs: Continuous Prescribed Grazing and Rotational Grazing. This separation provides better information on grazing practices and the basis for the willingness to adopt questions. Thus, the total number of BMPs in the analysis is sixteen. These sixteen BMPs can be characterized into three groups: 1) erosion and sediment control practices, 2) grazing management, and 3) mortality, nutrient and pesticide management.

The explanatory variables for the probit analyses were selected using previous literature and economic theory. Nineteen variables were selected for models of BMP adoption in beef cattle production. The variables are related to the farm operation, producer characteristics and land characteristics. Table 1 presents the explanatory variables and their definitions.

Size variables have received extensive attention among researchers whose goal is to explain adoption behavior in agricultural sector. As Feder *et al.* (1985) mentioned, the relationship between farm size and adoption may depend on fixed costs, risk preference, human capital, credit constraints, labor requirements, tenure arrangements, etc. Number of animals in the beef cattle herd (ANIMALS) was used as a proxy for farm size.

The purebred or seedstock operation is different from the commercial cow-calf operation, which is the most common type of operation in Louisiana. This operation demands greater

management and generally results in higher returns, as breeding stock prices are generally much higher than prices for animals produced for the purpose of eventual slaughter. Higher returns means the farm has greater investment flexibility. For this reason, one can expect the adoption rate of BMPs to be higher for the purebred or seedstock producer. Variable PUREBRED represents the production of purebred or seed stock in the operation.

Variable STOCKER represents the presence of stockers in the operation. Net returns from stocker operations have been generally higher than for cow-calf operations in recent years (Boucher and Gillespie, 2003). Thus, in the same fashion that raising purebred or seed stock was expected to lead to greater adoption, the relationship between raising stockers and adoption of BMPs was expected to be positive, as higher net returns would lead to greater investment.

Some BMPs may benefit not only beef cattle production but also other crops and/or livestock production. Thus, when a farm is engaged in more crops and/or livestock operations, the farmer is likely to adopt more BMPs. Fernandez-Cornejo *et al.* (1994) used crop diversification as an explanatory variable in the study on vegetable growers' adoption of Integrated Pest Management (IPM) technique. Results of the study indicated that there was a positive significant relationship between adoption of IPM and a crop diversification variable. Rahelizatovo (2002) also included crop diversification as an explanatory variable in the adoption of dairy BMPs. The variable was positive in the adoption of most dairy BMPs, but not significant. Variable CROPTOT represents the number of other crops and livestock operation included in a beef cattle farm and is expected to have positive relationship with BMP adoption.

Land ownership may play a very important role in the adoption of technology. Soule, Tegene and Wiebe (2000) showed the importance of land ownership in the adoption of conservation practices. Their results indicated that share-renters were more likely to adopt

conservation practices than cash-renters. Cardona (1999) indicated that tenure was an influential factor in the adoption of BMPs. In his study, sugarcane growers were not willing to implement BMPs on rented land. Fuglie and Bosch (1995) included a land ownership variable in their study of adoption of N fertilizer application, the variable was positive, but not significant. The variable RATIO_LN represents ratio of owned land used in the beef cattle operation in this study. This variable is hypothesized to positively influence the adoption of BMPs, due to the ability of the land owner to benefit from the implementation of conservation practices in the long run.

Exposure to information plays a very important role on the adoption of technology. A farmer must learn about a certain technology and understand its benefits and costs in order to make an informed adoption decision. Natural Resources Conservation Service (NRCS) assists the farmer to conserve, maintain, and improve natural resources and the environment. To achieve its goal, it promotes conservation programs through various routes such as hosting seminars, workshops and informing through its website, and assisting farmers with adoption of conservation practices. Farmers may apply for cost-share benefits such as EQIP through NRCS. Thus, having more frequent contact with NRCS affects a farmer's decision on conservation practice adoption directly. In this study, the form of contact included attending seminars or workshops and in-person, telephone and e-mail contacts. The variable NRCS was included as a dummy variable indicating whether one had contact with NRCS at least once in the year, 2002. It is hypothesized to have a positive relationship with adoption of BMPs.

Including Louisiana Cooperative Extension Service (LECS) in the model accounts for the impact of information on adoption in the same fashion as including NRCS. While NRCS focuses mostly on conservation practices, LCES deals with more diversified programs including community leadership, economic development, family and consumer science, 4-H youth

development, horticulture, livestock show, and forestry and natural resources. In this study, the variable LCES is included as a dummy indicating whether one had contact with LCES at least four times in the year, 2002. The form of contact accounted is same as the NRCS case. Variable LCES is expected to have a positive impact on the likelihood of adoption of BMPs.

Best Management Practices target the prevention of sediment reaching water bodies. Closer proximity to a stream or river may result in a higher delivery rate of sediment to the water body. Rahelizatovo (2002) found that having a stream or river running through a farm was significant in the adoption of Streambank and Shoreline Protection. The STRM variable represents having a stream or river running through the farm in this study. It is hypothesized to increase the likelihood of adoption of BMPs.

Having a family member to take over the farm is expected to influence BMP adoption decisions. When a farmer has offspring to take over the farm, this effectively extends his planning horizon, and future returns are discounted at a lower rate. The variable TOVER is included as a dummy variable.

Risk and uncertainty have been addressed in technology adoption studies (Feder *et al.*, 1985). It has been found that risk averse farmers selectively adopt technology that guarantees net expected marginal benefits. However, risk preference is not easy to measure. Thus, researchers have tried a number of different methods to measure farmers' attitudes towards risk (e.g. Gillespie and Fausti, 2000). In this study, risk preference is measured by asking the respondent to mark one among three choices regarding investment decisions. A question was asked as the following: "Relative to other investors, how would you characterize yourself?" and the choices were "I tend to take on substantial levels of risk in my investment decisions," "I neither seek nor avoid risk in my investment decisions," and "I tend to avoid risk when possible in my investment decisions."

The RISKAV variable represents risk averse attitude (respondents who marked the third choice) on investment decisions. When a farmer is risk averse, he or she would adopt more BMPs to prevent sudden soil loss or erosion in cases such as heavy rain fall events. Some BMPs (e.g. Cover and Green Manure Crop, Critical Area Planting, Field Borders and Filter Strips and Grassed Waterways) are specifically designed to prevent such damage. Therefore, the variable RISKAV is expected to have a positive influence on adoption of BMPs.

Age is often included in technology adoption studies. Most studies have found negative impacts of age on the adoption of technology (e.g. Soule *et al.*, 2000). Variable AGE has been divided by ten to reduce its magnitude for estimation purposes. It is hypothesized that older producers are less likely to adopt BMPs as they have shorter planning horizons and may not fully realize the long-term benefits of adoption.

Much literature has assessed the effect of education on technology adoption (Cooper, 2003; Soule *et al.*, 2002; Khanna, 2001; Wu and Babcock, 1998; Cooper and Keim, 1996; Dorfman, 1996; Fuglie and Bosch, 1995; Rahm and Huffman, 1984). Rahm and Huffman (1984) reported that farmers' schooling enhances the efficiency of the adoption decision. Wu and Babcock (1998) also included college education in their study and found it to be significant in models examining the adoption of conservation tillage, crop rotation and soil nitrogen testing. Variable BACHELOR is included as a dummy for having a college bachelor's degree. The more highly educated producer generally has the capacity to make better-informed decisions, and is more likely to be aware of production alternatives. Thus, BACHELOR is expected to increase the likelihood of adoption of BMPs.

A beef cattle producer's financial situation could play an important role in his or her technology adoption decision. Having higher income would increase the likelihood of adoption

of BMPs, as one has greater flexibility in investing in new technology when sufficient financial resources are present. HOUINC represents net household income in this study, and is coded as 1, 2, 3, 4, and 5 for less than \$30,000, \$30,000 to \$59,999, \$60,000 to \$89,000, \$90,000 to \$119,999 and more than \$120,000, respectively.

Percentage of total household income from the beef cattle operation is also included as an explanatory variable. Higher percentage of income from a crop or livestock enterprise would indicate greater concern for economic efficiency. Thus, variable BEEFINC is expected to have a positive relationship with adoption of BMPs in cases where the BMPs lead to long-term profitability. The variable BEEFINC is coded as 1, 2, 3, 4, and 5 for less than 20 percent, 21-40 percent, 41-60 percent, 61-80 percent and 81-100 percent, respectively.

Credit constraints may play an important role in the adoption of BMPs. When one has a high credit constraint, then the situation would impede the adoption of BMPs (Feder *et al.* 1985), especially on capital-intensive practices. On the other hand, a high debt load may have originated from investments that the farm recently made. Thus, there are admittedly some potential endogeneity issues associated with using a debt load variable as discussed by Feder *et al.* (1985). Respondents were asked to indicate their debt/asset ratio by choosing among five categories. Variable DEBT is coded as 1, 2, 3, 4, and 5 and they represent zero, 1-20 percent, 21-40 percent, 41-60 percent and over 60 percent of debt asset ratio, respectively.

Land characteristics are often included in BMP adoption studies. Four land characteristics were assessed including hilly, marsh, river bottom and prairie land. Three of them were used as dummy variables. The variable SOUTH is included to determine whether being in North or South Louisiana has an effect on BMP adoption.

In addition to the variables included in the adoption equations, two more explanatory variables were added to the willingness to adopt rotational grazing model(s). Variable BIDOFFER represents bid offers given to the respondents. Dummy variable DC, representing dichotomous choice format, was included to compare the effect of the two choice formats.

Cooper and Keim (1996) pioneered connecting the contingent valuation method into technology adoption studies. They found bid value to be significant in their study of ‘incentive payments to encourage farmer adoption of water quality protection practices.’ Cooper and Osborn (1998) used bid offer as an explanatory variable on ‘The effect of rental rates on the extension of conservation reserve program contracts’; and showed it to be a positively significant factor on deciding whether to extend conservation reserve program contracts. Cooper (2003) used bid value in his study on farmers’ perceptions of the desirability of adopting five conservation practices and found strong positive significance.

Variable DC is expected to have negative sign because use of the dichotomous choice format is expected to result in more conservative responses than the polychotomous choice format (in Ready *et al.*’s study (1995) this result was suggestive but not definite). Therefore, respondents are expected to answer “yes” less frequently than when using the dichotomous choice format.

Results

Table 2 provides weighted estimated adoption rates of BMPs in Louisiana beef cattle production. The weighting adjusts according to differences to the number of operations in the stratified sample. Larger farms were over-sampled, and smaller farms were under-sampled. More than four hundred eighty farms are included. For erosion and sediment control practices, the adoption rates range from 19 to 31 percent. For grazing management practices, they range from 57 to 75 percent. For Mortality, Nutrient, Pesticide Management practices, the adoption

rates range between 53 and 65 percent. Four percent of the farms adopted a Water Facility with a cost-share payment. The most common two reasons for non-adoption are ‘Not familiar with it.’ and ‘Not applicable to the farm.’ These two reasons account for the high rates of non-adoption of erosion and sediment control practices. However, the rates on ‘Not familiar with it’ are lower in Grazing Management, and Mortality, Nutrient and Pesticide Management practices. It is interesting that two to eight percent of farms responded that they ‘Prefer not to use it.’

Table 3 presents results from 16 weighted binomial probit models on adoption of BMPs. Size variable, ANIMALS, was not a significant factor in the adoption of BMPs, which was unusual. It was negatively significant in one practice (in equation Fence). Variable PUREBRED was significant in three models. Two models that showed positive significance were Water Facility and Continuous Prescribed Grazing. Variable STOCKER was negatively significant in four models. Those models were, Livestock Exclusion, Regulating Water, Riparian Forest Buffer, and Mortality Management. However, it was not significant in marginal effects for Mortality Management. The negative relationship was not expected.

Crop diversification, represented as variable CROPTOT, was significant in seven models with positive signs. Thus, crop diversification was significantly associated with increased likelihood of adopting BMPs in beef cattle production. Variable RATIOLN was positively significant in three models. The positive sign was consistent with hypotheses. The effect of contact with LCES and NRCS personnel was examined by variables LCES and NRCS. Variable LCES was significant in five models in its marginal effects; however, the impacts differed in direction. It was positively significant in three models and negatively significant in two models. Variable NRCS was significantly associated with increased adoption of seven BMPs.

The impact of having a stream or river running through the farm (STRM) had mixed results. In models for Water Facility and Rotational Grazing, the variable had negative signs, and for models Riparian Forest Buffer and Streambank and Shoreline Protection, the variable had positive signs. Having a family member to take over the beef cattle farm (TOVER) was significant in two models in its marginal effect on the adoption of BMPs. However, impact directions differed.

The farmers' tendency to avoid risk (RISKAV) had a negative impact on adoption of three BMPs, which was surprising. Variable AGE was expected to have negative signs initially, however it showed positive significant sign in four BMPs. Producers' level of educational attainment was included as variable BACHELOR, representing having a college bachelor's degree. As expected, it had positively significant impacts on the adoption of five BMPs, and a negatively significant impact on adoption of Mortality Management.

Financial aspects of beef cattle farms were hypothesized to have an impact on adoption of BMPs. Household net income was hypothesized to have a positive impact on the adoption of BMPs. Variable HOUINC had a positively significant relationship with adoption of four BMPs. Percentage of household net income from beef cattle operation was included as variable BEEFINC, and was expected to increase the probability of adopting BMPs. The results suggested its association with significant increases in the adoption of six BMPs, as expected. Debt-asset ratio was included as variable DEBT in models, and had mixed results with two positive and one negative significant signs.

Four land characteristics were included: HILLY, MARSH, RIVBOT and SOUTH. The first three land characteristics were compared with prairie land. Variable HILLY was found significantly associated with increased adoption of six BMPs, all of which belong to the erosion

and sediment control practices category. Variable MARSH was negatively significant in one model and variable RIVBOT was positively significant in three models. Variable SOUTH was found significantly associated with increased adoption of three BMPs and decreased adoption of one BMP.

Table 4 presents the results of the probit analysis on willingness to adopt rotational grazing. A higher bid offer would lead a farmer to be more willing to adopt a rotational grazing system. Increasing the bid offer of the cost-share by one percent would increase the probability of adopting by 0.5 percent, holding other variables constant. Having a family member to take over the farm would lead the farmer to be more likely to adopt. This would increase the probability of acceptance by 16 percent, holding other variables constant. Older farmers are less likely willing to adopt; an increase in the farmer's age by ten years would decrease the probability of acceptance by five percent. Producers in higher debt are more likely willing to adopt; an increase in the debt-asset ratio by ten percent would increase the probability of adoption by nine percent. Being located in South Louisiana would lead to greater probability of adoption. Very limited evidence exists to suggest that farmers answering under the dichotomous format would be less likely to answer that they would adopt.

Conclusions

Adoption of BMPs in beef cattle production was investigated in this study. Adoption rates were especially low in practices that target erosion and sediment control, ranging 19 to 31 percent. The two most frequently cited reasons for non-adoption were non-familiarity and non-applicability to the farm. This means the beef cattle producers lacked sufficient information on BMPs. The reason of non-applicability may also have originated from a lack of knowledge of the BMPs. This suggests that there is much room for increased educational programs through

institutions such as NRCS and LCES if society wishes to increase adoption rates. Educating the majority of cattle producers about BMPs is likely, however, to pose a significant challenge, given that a large portion of beef cattle producer population is part-time, hobby-farmers.

A series of probit analyses was conducted to examine factors affecting adoption of BMPs in Louisiana beef cattle production. Conclusions from the series of probit analyses for current adoption of BMPs in beef cattle production include: 1) More diversified farmers are more likely to adopt BMPs targeting erosion and sediment control, as the BMPs may benefit not only beef cattle production, but also other crops and/or livestock enterprises. 2) Increased contact with NRCS personnel positively affects BMP adoption. Thus, if greater adoption is desired, increased effort through NRCS may be effective in reaching that end. 3) Increased contact with LCES personnel had mixed effects on the adoption of beef production BMPs. This likely is the result of LCES's greater previous focus on programs besides BMP adoption. It is, however, expected that programs such as the relatively new Master Farmer Program, which is specifically set up to enhance BMP adoption, will lead LCES to have greater influence on BMP adoption. Thus, one might expect to see different results in a few years.

4) The effect of having a stream or a river running through the farm had mixed results, depending on BMP. A stream was an impediment for adopting a Water Facility or Rotational Grazing. However, it had a positive impact on the adoption of Riparian Forest Buffer and Streambank and Shoreline Protection. 5) Producers' level of education had a powerful impact on the adoption of BMPs. This suggested that greater ability to process information leads to greater BMP adoption. 6) Percentage of total household income from the beef cattle operation had a positive effect on the adoption of BMPs, suggesting the importance of capital availability

on the propensity to adopt BMPs. 7) Operating beef cattle on hilly land greatly influenced the adoption of BMPs. Land descriptors were significant factors in BMP adoption.

Socioeconomic factors affecting the willingness to adopt a rotational grazing system were analyzed using a probit analysis. The results indicated the following: 1) As expected, higher bid offers would lead farmers to be more willing to adopt a rotational grazing system. This suggests that if the Federal Government desires to enhance adoption of BMPs, the setting of the cost-share rate will significantly affect the adoption rate. 2) Having a family member to take over the farm would lead the farmer to be more likely to adopt. The result indicated that when a farmer has offspring to take over the farm, this effectively extends his planning horizon. This also indicates the farmers' realization of the positive longer term impacts of BMP adoption. 3) Older farmers are less likely willing to adopt, as they expect they would benefit less from the investment, given that the benefits are generally longer term in nature. 4) Farmers under high debt are more likely willing to have adopted. 5) Being located in South Louisiana would lead farmers to more likely to adopt a rotational grazing system. 6) Respondents answering under the dichotomous choice format were less willing to adopt a rotational grazing system. More work, however, needed to verify this result since the differences in willingness to adopt were only marginally (at the 10.2 percent level) significant.

Continuous promotion and education on conservation would induce beef cattle producers to adopt more conservation practices, as the results revealed the role of NRCS in influencing the adoption of BMPs. Higher cost-share offers along with educational efforts would induce more adoption of rotational grazing.

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Table 1. Definitions of Explanatory Variables

Variables	Definition	Mean	Std. Dev.
ANIMALS	Number of animals in beef cattle divided by 100.	1.276	2.383
PUREBRED	Dummy for purebred or seedstock cattle operation.	0.146	0.353
STOCKER	Dummy for stocker operation.	0.061	0.239
CROPTOT	Number of farming activities including crops and other livestock.	1.076	1.099
RATIOLN	Ratio of owned land in beef cattle operation.	0.682	0.376
NRCS	Dummy for having contact with NRCS at least once in the year, 2002.	0.360	0.481
LCES	Dummy for having contact with LCES at least four times in the year, 2002.	0.145	0.352
STRM	Dummy for a stream or river running through the farm.	0.423	0.495
TOVER	Dummy for whether any family member plans to take over the farm.	0.274	0.446
RISKAV	Dummy for a risk averse farmer.	0.706	0.456
AGE	Age of the respondent divided by 10.	5.861	1.256
BACHELOR	Dummy for having a college bachelor's degree.	0.315	0.465
HOUINC	Household net income coded 1,2,3,4,5 for increments of \$30,000.	2.445	1.257
BEEFINC	Percentage of household net income coming from the beef cattle operation, coded 1,2,3,4,5 for increments of 20 percent.	1.327	0.804
DEBT	Debt-Asset ratio, coded 1,2,3,4,5 for increments of 20 percent.	1.688	1.007
HILLY	Dummy for hilly land used for beef cattle grazing.	0.416	0.493
MARSH	Dummy for marsh land used for beef cattle grazing.	0.093	0.290
RIVBOT	Dummy for river bottom land used for beef cattle grazing.	0.167	0.373
SOUTH	Dummy for being located in South Louisiana.	0.527	0.499
BIDOFFER	Bid offers in percentage from 60 to 100 in increments of 10 percent.	80.556	13.760
DC	Dummy for dichotomous choice format.	0.501	0.501

Table 2. Weighted Beef Cattle Producers' Adoption Rates of BMPs

Practices	Farms	<u>Percentage Adopted</u> Sources of the Cost				<u>Percentage Not Adopted</u> Reasons for Non- Adopting						
		C1	C2	C3	Total	R1	R2	R3	R4	R5	R6	Total
<u>Erosion and Sediment Control Practices</u>												
Cover and Green Manure Crop	484	0	0	23	23	26	37	3	3	7	1	77
Critical Area Planting	483	0	2	23	25	21	42	2	4	5	1	75
Field Borders and Filter Strips	476	1	2	25	28	28	35	1	4	3	1	72
Grassed Waterways	480	1	1	22	24	31	36	2	3	3	1	76
Heavy Use Area Protection	483	1	0	30	31	27	30	4	4	3	1	69
Livestock Exclusion	480	0	1	24	25	20	42	2	3	7	1	75
Regulating Water	482	0	2	17	19	22	48	4	3	3	1	81
Riparian Forest Buffer	483	0	0	21	21	25	47	1	2	3	1	79
Streambank and Shoreline Protection	487	0	0	24	24	20	48	3	2	2	1	76
<u>Grazing Management</u>												
Fence	487	1	2	62	65	13	15	2	2	3	0	35
Water Facility	487	1	4	70	75	4	14	1	2	3	1	25
Continuous Prescribed Grazing	480	1	0	66	67	8	12	1	3	8	1	33
Rotational Grazing	480	1	2	54	57	7	17	3	7	8	1	43
<u>Mortality, Nutrient and Pesticide Management</u>												
Mortality Management	481	0	0	65	65	11	7	5	3	8	1	35
Nutrient Management	475	1	2	50	53	17	19	3	3	4	1	47
Pesticide Management	480	1	0	60	61	12	17	2	1	6	1	39

C1: With an Incentive Payment; C2: With Cost-Share Payment; C3: With Own Expense; R1: Not Familiar; R2: Not Applicable to the Farm; R3: Too High Cost; R4: Still Considering It; R5: Prefer Not to Use It; R6: Reason is Not Given.

Table 3. Weighted Probit Results for Adoption of BMPs in Beef Cattle Production, Louisiana.

Variables	Cover and Green			Critical Area Planting			Field Borders and			Grassed Waterways		
	β	M		β	M		β	M		β	M	
CONSTANT	-2.5582***	-0.6924***		-2.6702***	-0.8105***		-3.1096***	-0.9924***		-3.6645***	-1.0610**	
ANIMALS	-0.0631	-0.1709		-0.0581	-0.0176		-0.0217	-0.0069		0.0153	0.0044	
PUREBRED	-0.0635	-0.1686		-0.1353	-0.0396		-0.0054	-0.0017		0.0903	0.0267	
STOCKER	-0.1565	-0.0397		-0.1017	-0.0297		-0.2162	-0.0642		-0.2561	-0.0670	
CROPTOT	0.0353	0.0096		0.1497**	0.0454**		0.2677***	0.0851***		0.2213***	0.0640***	
RATIOLN	0.0155	0.0042		0.1448	0.0439		0.4088*	0.1304*		0.3863	0.1118	
NRCS	0.2325	0.0650		0.4574***	0.1456***		0.2830*	0.0928		0.2368	0.0706	
LCES	0.2627	0.0769		-0.4208*	-0.1124*		0.3391	0.1163		0.0204	0.0059	
STRM	0.2494	0.0686		0.1930	0.0592		0.1067	0.0342		0.0473	0.0137	
TOVER	-0.3322*	-0.0829*		0.1249	0.0388		-0.0253	-0.0080		0.3056*	0.0940	
RISKAV	-0.4634***	-0.1358***		-0.0124	-0.0037		-0.0362	-0.0116		-0.0175	-0.0050	
AGE	0.1443*	0.0391*		0.1299*	0.0394*		0.0911	0.0290		0.1955***	0.0566**	
BACHELOR	-0.1645	-0.0434		0.2019	0.0627		0.4279**	0.1420**		0.4744***	0.1452**	
HOUNC	0.1257*	0.0340*		0.0049	0.0014		0.0344	0.0109		-0.0112	-0.0032	
BEEFNC	0.4268***	0.1155***		0.1709	0.0518		0.2728**	0.0870**		0.2774**	0.0803*	
DEBT	0.0494	0.0134		0.1491*	0.0452*		0.1830**	0.0584**		0.1217	0.0352	
HILLY	0.3421*	0.0950*		0.3902**	0.1210**		0.2022	0.0652		0.4775***	0.1210***	
MARSH	0.4362	0.1356		-0.2684	-0.0745		0.1043	0.0342		-0.0419	-0.0119	
RIVBOT	0.05457**	0.1695**		0.0928	0.0288		0.4737**	0.1647**		0.1888	0.0573	
SOUTH	-0.1034	-0.0280		0.2593	0.0783		0.4167**	0.1318**		0.3655**	0.1051**	
Observations	370			369			366			369		
MaFadden's R ²	0.109			0.092			0.136			0.138		
% Correctly Predicted	75.41			73.71			71.04			74.80		

β : Values of the Parameters; M: Marginal Effects; ***: Values significant at 1 % level; **: Values significant at 5 % level; *: Values significant at 10 % level.

Table 3. Continued.

Variables	Heavy Use Area Protection		Livestock Exclusion		Regulating Water		Riparian Forest Buffer	
	β	M	β	M	β	M	β	M
CONSTANT	-1.6871***	-0.5894***	-1.6280***	-0.5075***	-1.9279***	-0.4679***	-3.0522***	-0.7281***
ANIMALS	0.0449	0.0157	-0.0807	-0.0251	0.0598	0.1452	0.0175	0.0041
PUREBRED	0.3501*	0.1287	-0.1084	-0.0328	0.2316	0.0607	-0.0192	-0.0045
STOCKER	-0.2509	-0.0819	-0.5663	-0.1423*	-0.9607*	-0.1424***	-0.9514*	-0.1385***
CROPTOT	0.0963	0.0336	0.1944**	0.0606**	-0.0411	0.0099	0.2474***	0.0590***
RATIOLN	0.1289	0.0450	0.1549	0.0483	0.3266	0.0792	0.8825***	0.2105***
NRCS	0.1290	0.0455	0.0385	0.1207	0.1766	0.0441	0.1062	0.0257
LCES	-0.1299	-0.0442	0.0486	0.0153	0.3973*	0.1100	-0.1777	-0.0396
STRM	0.1810	0.0636	0.1381	0.0434	0.0834	0.0203	0.6049***	0.1511***
TOVER	-0.0284	-0.0099	0.3793**	0.1256**	0.0492	0.0121	0.0832	0.0202
RISKAV	0.1308	0.0450	0.0200	0.0062	-0.2038	-0.0516	-0.0449	-0.0108
AGE	-0.0013	-0.0004	-0.0475	-0.0148	0.0324	0.0078	0.0578	0.0138
BACHELOR	0.4747***	0.1708***	0.5480***	0.1797***	0.1359	0.0337	0.3175	0.0797
HOUNC	0.0244	0.0085	0.1147*	0.0357*	-0.0223	-0.0054	-0.0587	-0.0140
BEEFNC	0.1647	0.0575	0.2655**	0.0827**	0.2081*	0.0505*	0.2896**	0.0691**
DEBT	0.0115	0.0040	0.0049	0.0015	0.0477	0.0115	0.0526	0.0125
HILLY	0.4301***	0.1522***	0.1691	0.0533	0.2931	0.0730	0.6055***	0.1522***
MARSH	0.2237	0.0815	-0.2527	-0.0727	-0.1322	-0.0303	-0.4847	-0.0929
RIVBOT	0.2600	0.0944	-0.2245	-0.0662	-0.2936	-0.0643	-0.0017	-0.0004
SOUTH	0.0862	0.0300	0.0482	0.0150	0.2151	0.0520	0.0366	0.0087
Observations	369		366		370		372	
McFadden's R ²	0.065		0.105		0.058		0.167	
% Correctly Predicted	69.38		74.59		81.08		79.57	

β : Values of the Parameters; M: Marginal Effects; ***: Values significant at 1 % level; **: Values significant at 5 % level; *: Values significant at 10 % level.

Table 3. Continued.

Variables	Streambank and Shoreline Protection			Fence		Water Facility		Continuous Prescribed Grazing	
	β	M	β	β	M	β	M	β	M
CONSTANT	-2.3284***	-0.7289***	0.4176	0.1481	0.3655	0.1080	1.2276**	0.4282**	
ANIMALS	0.0192	0.0060	-0.0857*	-0.0304*	-0.0174	-0.0051	0.1146	0.0399	
PUREBRED	0.1688	0.0549	-0.3140	-0.1164	0.7813**	0.1809***	0.5354**	0.1645***	
STOCKER	0.0069	0.0021	-0.1876	-0.0690	0.0409	0.0119	-0.3845	-0.1438	
CROPTOT	0.0048	0.0015	-0.0430	-0.0143	0.0064	0.0019	-0.0745	-0.0259	
RATIOLN	0.4033*	0.1262*	0.0242	0.0086	0.1476	0.0436	-0.2288	-0.0798	
NRCS	0.2778*	0.0894	-0.0521	-0.0185	0.0755	0.0221	0.5813***	0.1908***	
LCES	0.0311	0.0098	0.4967**	0.1578**	0.4976*	0.1257**	-0.6749***	-0.2549***	
STRM	0.3912**	0.1246**	0.1452	0.0511	-0.3786**	-0.1141**	-0.1546	-0.0542	
TOVER	-0.0984	-0.0302	-0.1721	-0.0623	-0.0799	-0.0240	-0.1406	-0.0499	
RISKAV	0.1136	0.0349	-0.2124	-0.0734	-0.4439**	-0.1212**	0.1158	0.0408	
AGE	0.0814	0.0254	-0.0487	-0.0172	0.0426	0.0126	-0.0819	-0.0285	
BACHELOR	0.2351	0.0754	0.1646	0.0575	-0.2408	-0.0733	-0.1895	-0.0670	
HOUNC	0.0373	0.0116	0.1783***	0.0632***	0.0985	0.0291	-0.0002	-0.0001	
BEEFNC	0.1731	0.0542	0.0131	0.0046	0.1186	0.0350	0.2528	0.0882	
DEBT	0.0263	0.0082	0.0165	0.0058	-0.0375	-0.0111	-0.1435*	0.0500*	
HILLY	0.3719**	0.1187**	-0.0941	-0.0335	-0.3670**	-0.1108**	-0.1623	-0.0570	
MARSH	0.3128	0.1059	0.3053	0.1008	0.1942	0.0537	0.0808	0.0277	
RIVBOT	0.1754	0.0570	-0.1245	-0.0450	0.6425**	0.1569***	-0.3486	-0.0276	
SOUTH	-0.2332	-0.0731	0.1502	0.0533	0.2561	0.0758	-0.3079**	-0.1068**	
Observations	373		371		370		365		
McFadden's R ²	0.072		0.064		0.122		0.063		
% Correctly Predicted	74.26		65.77		75.68		70.14		

β : Values of the Parameters; M: Marginal Effects; ***: Values significant at 1 % level; **: Values significant at 5 % level; *: Values significant at 10 % level.

Table 3. Continued.

Variables	Rotational Grazing		Mortality Management		Nutrient Management		Pesticide Management	
	β	M	β	M	β	M	β	M
CONSTANT	-0.2855	-0.1117	0.6142	0.1988	-0.7733	-0.3049	-0.8323	-0.3103
ANIMALS	-0.0377	-0.0147	0.0418	0.0136	-0.0457	-0.0180	0.0401	0.0149
PUREBRED	0.0979	0.0380	0.1272	0.0401	-0.0327	-0.0129	0.0544	0.0201
STOCKER	-0.3148	-0.1249	-0.5682*	-0.2083	-0.0560	-0.0221	-0.1872	-0.0716
CROPTOT	0.0195	0.0076	-0.0080	-0.0026	0.1281*	0.0505*	0.1564**	0.0583**
RATIOLN	0.0292	0.0114	0.1597	0.0518	0.0831	0.0327	-0.2941	-0.1096
NRCS	0.3018*	0.1164*	0.2555	0.0806	0.4876***	0.1878***	0.5329***	0.1901***
LCES	0.0790	0.0307	0.3995	0.1166*	0.2864	0.1102	0.1972	0.0713
STRM	-0.2836**	-0.1110**	-0.0582	-0.0189	-0.1740	-0.0687	-0.0922	-0.0344
TOVER	-0.0051	-0.0020	0.1001	0.0319	0.1144	0.0448	0.2284	0.0830
RISKAV	-0.4008**	-0.1527**	-0.0593	-0.0191	-0.0044	-0.0017	0.0623	0.0233
AGE	0.0437	0.0171	0.0089	0.0028	0.0074	0.0029	0.1117*	0.0416*
BACHELOR	-0.0383	-0.0150	-0.5026***	-0.1706***	0.2707*	0.1056*	0.2013	0.0740
HOUNC	0.1298**	0.0508**	0.0848	0.0275	0.0869	0.0342	0.1042	0.0388
BEEFNC	0.0959	0.0375	-0.0129	-0.0042	0.1666	0.0657	0.0028	0.0010
DEBT	0.0256	0.0100	-0.0695	-0.0225	-0.0267	-0.0105	-0.0908	-0.0388
HILLY	-0.2063	-0.0808	-0.4576***	-0.1517***	0.1290	0.0507	0.1470	0.0544
MARSH	-0.0237	-0.0093	-0.5494**	-0.1989**	0.0433	0.0170	-0.2307	-0.0884
RIVBOT	-0.1846	-0.0728	-0.0425	-0.0139	0.0450	0.0177	-0.2486	-0.0950
SOUTH	0.3247**	0.1266**	0.1429	0.0464	0.1181	0.0466	0.2507*	0.0934*
Observations	366		378		361		367	
McFadden's R ²	0.052		0.053		0.070		0.081	
% Correctly Predicted	61.75		69.31		62.88		67.85	

β : Values of the Parameters; M: Marginal Effects; ***: Values significant at 1 % level; **: Values significant at 5 % level; *: Values significant at 10 % level.

Table 4. Weighted Probit Results for Willingness to Adopt a Rotational Grazing System

Variable	Rotational Grazing System			
	β	β /Std. Err.	M	M/Std. Err.
CONSTANT	-0.6918	-0.890	-0.2759	-0.890
BIDOFFER	0.0137**	2.226	0.0054**	2.226
DC	-0.2757	-1.626	-0.1096	-1.636
ANIMALS	-0.0152	-0.264	-0.0060	-0.264
PUREBRED	0.2296	0.817	0.0908	0.828
STOCKER	0.1801	0.379	0.0713	0.383
CROPTOT	-0.0938	-1.003	-0.0374	-1.003
RATIOLN	-0.0618	-0.250	-0.0246	-0.250
NRCS	0.1159	0.588	0.0461	0.590
LCES	-0.2197	-0.745	-0.0873	-0.752
STRM	-0.0829	-0.476	-0.0330	-0.476
TOVER	0.4130**	0.201	0.1622**	2.062
RISKAV	-0.2787	-1.432	-0.1104	-1.449
AGE	-0.1265*	-1.703	-0.0504*	-1.703
BACHELOR	0.0286	1.292	0.1065	1.305
HOUINC	-0.0028	-0.035	-0.0011	-0.035
BEEFINC	-0.0777	-0.502	-0.0310	-0.502
DEBT	0.2360***	2.254	0.0941**	2.254
HILLY	0.1544	0.828	0.0615	0.830
MARSH	-0.0247	-0.085	-0.0098	-0.085
RIVBOT	0.4380	1.639	0.1708*	1.710
SOUTH	0.4730***	2.685	0.1868***	2.736
Observations	281			
McFadden's R ²	0.146			
% Correctly Predicted	69.40			

β : Values of the Parameters; M: Marginal Effects; ***: Values significant at 1 % level;
 **: Values significant at 5 % level; *: Values significant at 10 % level.